REPORT OF SURVEY CONDUCTED AT

CORPUS CHRISTI ARMY DEPOT
CORPUS CHRISTI, TX

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Best Manufacturing Practices

BEST MANUFACTURING PRACTICES CENTER OF EXCELLENCE
College Park, Maryland
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Foreword

This report was produced by the Best Manufacturing Practices (BMP) program, a unique industry and government cooperative technology transfer effort that improves the competitiveness of America's industrial base both here and abroad. Our main goal at BMP is to increase the quality, reliability, and maintainability of goods produced by American firms. The primary objective toward this goal is simple: to identify best practices, document them, and then encourage industry and government to share information about them.

The BMP program set out in 1985 to help businesses by identifying, researching, and promoting exceptional manufacturing practices, methods, and procedures in design, test, production, facilities, logistics, and management — all areas which are highlighted in the Department of Defense's 4245-7.M, *Transition from Development to Production* manual. By fostering the sharing of information across industry lines, BMP has become a resource in helping companies identify their weak areas and examine how other companies have improved similar situations. This sharing of ideas allows companies to learn from others' attempts and to avoid costly and time-consuming duplication.

BMP identifies and documents best practices by conducting in-depth, voluntary surveys such as this one at Corpus Christi Army Depot conducted during the week of January 26, 1998. Teams of BMP experts work hand-in-hand on-site with the activity to examine existing practices, uncover best practices, and identify areas for even better practices.

The final survey report, which details the findings, is distributed electronically and in hard copy to thousands of representatives from government, industry, and academia throughout the U.S. and Canada — *so the knowledge can be shared.* BMP also distributes this information through several interactive services which include CD-ROMs, BMPnet, and a World Wide Web Home Page located on the Internet at http://www.bmpcoe.org. The actual exchange of detailed data is between companies at their discretion.

Corpus Christi Army Depot is the Army's only organic facility for the repair and overhaul of rotary wing aircraft. The Depot is a major contributor of the Army, Navy, Marine Corps, and Air Force readiness through repair, overhaul, and maintenance of a wide variety of helicopters as well as related engines and components. Corpus Christi Army Depot is a full-service facility with the ability to restore airframes, engines, and components to like-new condition including crash-damaged aircraft. Since it began, Corpus Christi Army Depot has overhauled or repaired more than 12,922 aircraft.

The Best Manufacturing Practices program is committed to strengthening the U.S. industrial base. Survey findings in reports such as this one on Corpus Christi Army Depot expand BMP's contribution toward its goal of a stronger, more competitive, globally-minded, and environmentally-conscious America.

I encourage your participation and use of this unique resource.

Ernie Renner
Director, Best Manufacturing Practices

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Section 1

Report Summary

Background

Corpus Christi Army Depot (CCAD) is the Army's only organic facility for the repair and overhaul of rotary wing aircraft. The Depot is a major contributor of the Army, Navy, Marine Corps, and Air Force readiness through repair, overhaul, and maintenance of a wide variety of helicopters as well as related engines and components. CCAD seeks and meets the challenges of global military demands through three major areas:

- Overhaul, repair, modification, retrofit, and modernization: CCAD performs overhaul, repair, modification, retrofit, and modernization for Army and numerous Department of Defense rotary wing aircraft.
- Training: CCAD provides hands-on training for Reserve, National Guard, active duty, and friendly foreign military personnel.
- Additional depot maintenance support: CCAD provides additional depot maintenance support including on-site maintenance teams; crash damage analysis; and chemical, metallurgical, and technical support.

CCAD overhauls Army and other services' helicopters. The Depot provides for receipt, storage, overhaul, repair, modification, retrofit, maintenance, and other functions to aircraft and related aeronautical items. In support of these programs, the Depot purchases commercial supplies, repair parts, materiel, and equipment. In 1997, the Depot locally procured supplies and services totaling $23.9 million.

CCAD possesses extensive manufacturing capabilities that utilize conventional and advanced technology processes including Computer Aided Design and Manufacturing. This provides rapid, economical machining of a wide variety of ferrous and nonferrous materials. The Depot uses computer-aided manufacturing systems to create Computer Numerically Controlled programs in both conventional and Binary Cutter Location formats. CCAD fabricates aircraft parts that are not currently available from standard sources, enabling the Depot to provide timely aviation maintenance service to customers.

Established in 1961 as the United States Army Aeronautical Depot Maintenance Center, CCAD began as a depot-level maintenance facility for fixed and rotary wing aircraft. The Depot was tasked with repair and maintenance of three engines and four airframes. The first Bell Helicopter UH-1 (Huey) was overhauled in 1962. In 1967, CCAD's mission to overhaul and repair fixed wing aircraft was phased out due to increased demand for helicopter airframes, engines, and components. By 1968, the Facility was in full operation providing repair and overhaul services to approximately 400 helicopters annually. The name was changed to Corpus Christi Army Depot in 1974.

Today, CCAD provides helicopter repair and overhaul capability to all the U.S. military services, as well as numerous foreign military organizations. Thirty percent of CCAD's workload is obtained from other services and includes the SH-60 Seahawk, AH-1W Super Cobra Attack Helicopter, MH-60 Pavehawk, and UH-1N Huey Helicopter.

CCAD is a full-service facility with the ability to restore airframes, engines, and components to like-new condition including crash-damaged aircraft. Since it began, CCAD has overhauled or repaired more than 12,922 aircraft. The average total funded workload, based on 1997 history, is $307 million.

CCAD employs over 2,700 civilians, seven military personnel, and 175 contractor personnel. The Depot's current annual payroll is $162.6 million. CCAD utilizes 140 acres, controls 1.9 million square feet of floor space, and is a major tenant on the Naval Air Station. Other tenants include Chief of Naval Air Training; U.S. Coast Guard/Air Station; Drug Enforcement Agency; Medical Naval Hospital; Mine Warfare Command; and Defense Distribution Depot (sub-organization to Defense Logistics Agency). The BMP survey team considers the following practices to be among the best in industry and government.

Best Practices

The following best practices were documented at Corpus Christi Army Depot:

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Analytical Investigation	**5**

CCAD's Analytical Investigation Branch provides accident investigation service for rotary wing aircraft and Army fixed wing aircraft. The Analytical Investigation Branch also provides

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mishap investigation for a variety of ground vehicles and has established itself as the Department of Defense expert in the analysis of mishaps and failures of rotary wing aircraft and components.	
Bearing Shop	5
CCAD has a state-of-the-art bearing shop which performs acceptance testing of new bearings and the repair of used bearings. In 1997, the bearing shop generated a $9.8 million cost savings by reclaiming used bearings versus procuring new bearings.	
Thread Measurement Process	6
CCAD purchased an Apeirion Laser Thread Measuring Machine to perform inspection of critical aircraft components. Use of the machine has reduced CCAD's costs associated with calibrating and maintaining specialized gages. The laser thread measurement machine provides CCAD with a fast, accurate inspection system that can be used to conduct measurements on a variety of thread standards.	
Advanced Metal Finishing Processes and Facility	6
CCAD operates a new metal finishing facility. This facility is one of the most advanced metal finishing facilities in the Department of Defense. The new facility provides environmental compliance and has greatly improved safety and productivity.	
Depot Maintenance Hazardous Material Management System	8
CCAD pioneered the Depot Maintenance Hazardous Material Management System which is often referred to as a hazardous material pharmacy program. With the fielding of the Depot Maintenance Hazardous Material Management System in November 1993, CCAD is able to manage all inventories of hazardous materials. Operating like a pharmacy, the program controls authorized access and ensures proper issuance of only the amount necessary for the job to be performed. This program has substantially reduced procurement of hazardous materials.	
Plastic Media Blasting Process	8
CCAD is successfully using Plastic Media Blasting to remove paint from helicopter airframes. CCAD is equipped with a large facility for Plastic Media Blasting complete helicopter airframes and blasting cabinets for smaller components. The Plastic Media Blasting process eliminates the concerns associated with chemical paint stripping.	
Pollution Prevention	9
CCAD has proactively complied with United States Environmental Protection Agency and the State of Texas environmental regulations. The Depot's pollution prevention program has been a key factor in attaining full compliance with environmental regulations, as well as producing operation and maintenance cost savings.	
Programmed Depot Maintenance Scheduling System on the Web Page	9
CCAD utilizes the World Wide Web to distribute information to its customers. The Programmed Depot Maintenance Scheduling System was initiated in 1993, providing program management and scheduling tools.	
Wheat Starch Abrasive Media	10
CCAD has successfully depainted helicopter composite material surfaces using wheat starch based abrasive blasting material. CCAD uses a proprietary starch media, commercial blasting, and recycling equipment. The benefits obtained include minimum damage to composite surfaces, improved paint adhesion, reuse of media, and overall cost savings.	
Adaptation of Monarch for Depot Use	10
CCAD purchased a commercial software package, Monarch for Windows, that enables it to store, retrieve, and view electronic reports from its file server. Through the use of Monarch, CCAD estimates an annual printing cost savings of $75,000 to $80,000.	
High Performance Training	10
CCAD is developing and implementing action-oriented initiatives and training programs designed to provide its personnel with the skills and knowledge necessary to achieve higher levels of performance. CCAD is motivated to become a High Performance Organization.	
Operation Paint Brush and Operation Christmas Spirit	11
CCAD participates in several community programs to provide assistance to elderly or handicapped citizens. Through Operation Paint Brush, Depot employees have voluntarily painted more than 280 homes. Through Operation Christmas Spirit, CCAD provides gifts and fruit baskets to community residents living in 16 nursing homes.	

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Strategic Planning Process	12
CCAD developed and implemented a disciplined strategic planning process. The process has provided a clear roadmap to the future for the Depot, and a tool to control and manage the course and pace of change.	
VISA Credit Card Software	13
CCAD has developed software which eliminates the need for generating hard copy purchase requests for IMPAC VISA credit card purchases. The database also maintains purchase records for generating summary reports.	
Wellness Program	13
CCAD benchmarked effective work site wellness programs in industry, studied the benefits of work site wellness, and examined the range of items the Depot could sponsor within regulatory guidelines. Since establishing the Wellness Program, the Depot has seen improvements in morale, employee energy, creativity, productivity, and health.	

Information

The following information items were documented at Corpus Christi Army Depot:

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Apache Helicopter Pre-Modification Process	15
The Army has begun a remanufacturing effort to modify up to 758 AH-64A helicopters to the AH-64D configuration. The modification will be performed as a joint venture between CCAD and McDonnell Douglas (now Boeing). CCAD provides the skills and expertise related to the disassembly and maintenance of the AH-64.	
Material Management Process Improvement Initiative	15
CCAD's material management process improvement initiative targets schedule conformance—meeting production schedules by getting the correct materials, to the correct location, in right condition, and at the correct time. The Depot's goal is to achieve a 70% reduction in cycle time for the flow of material and supplies.	
Powder Coating Technology	16
CCAD has installed powder coating facilities and employs the technology for corrosion resistance and aesthetics on aerospace components. Powder coating technology is an alternative method to liquid coating protection for materials. The technology does not use solvents, thereby reducing pollution of the environment. The Depot has achieved cost savings in excess of $300,000 through the use of powder coating technology.	
Shot Peening Program	16
CCAD has upgraded its shot peening program to include hardware and software upgrades, process control, and operator training and certification. These improvements have increased efficiency and capability of the Depot's shot peening program. The shot peening operation is now in a position to comply with AMS 2432B.	
Waterjet Numerically Controlled Machining Center	17
CCAD purchased a custom Waterjet Numerically Controlled Machining Center for removing coatings from surfaces. Use of the waterjet system greatly reduces the production of hazardous waste when compared to a chemical removal process.	
Web Based Data Collection System	18
CCAD purchased hardware and software to implement a new Web based intranet data collection system. When completed, the data collection system will provide access to financial, personnel, material, and labor information.	
Spill Management Team	19
CCAD is a Treatment, Storage, and Disposal facility as defined by the Resource Conservation and Recovery Act of 1976. CCAD entered into an inter-service support agreement with the Naval Air Station fire department. Under this agreement, the Naval Air Station fire department is the first unit to respond to CCAD hazardous spills. The fire department contains the material, then the CCAD Spill Management Team performs cleanup and removal of the waste. The Spill Management Team has heightened employee awareness of hazardous waste handling rules and regulations, which has contributed to a decrease in the number of occurrences of hazardous waste spills.	
360 Degree Assessment	19
As part of CCAD's strategic plan to develop into a High Performance Organization, a 360 degree assessment on individual performances is being piloted in the Corporate Performance Office for	

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eventual implementation throughout the Depot. Benefits of this feedback in pursuing a High Performance Organization are already being realized.

Activity Based Costing Efforts 20

Since 1996, CCAD has used Activity Based Costing to support process improvements. Activity Based Costing is being used to support the Depot's efforts to become certified in the contractor performance certification program.

Building High Performance Teams Through Experiential Education 20

High performance organizational training was adopted at CCAD to provide managers and employees with a methodology to diagnose the organization, determine what areas needed attention, and to use the appropriate levers to improve those areas requiring assistance. With the assistance of high performance training, CCAD is able to review its present method of conducting business, and bridge the gaps that exist between current operations and what it ascertains is high performance.

Civilian Personnel Advisory Center 21

The CCAD personnel process was transferred to the regional Civilian Personnel Operations Center on March 1, 1997. CCAD established a transition team one-and-one-half years prior to the scheduled transfer date. The transition team implemented methods to assure a smooth and effective transition process.

Continuous Improvement Process Regulation 21

CCAD developed a local regulation, the Continuous Improvement Process, which defines executive, senior, division, and branch level leadership teams. It also defines the interrelationship of the teams, as well as their role in performing continuous improvement for the Installation. This regulation provides the Depot with a blueprint for attaining high performance goals in cost, quality, and schedule.

Executive Leadership Team 22

CCAD established an Executive Leadership team. The purpose of the team is to focus Depot resources toward improving overall performance. Specifically, the team targets the areas of leadership, vision, values, strategy, structure, and systems. Working these areas concurrently allows the Depot to focus on its goals of excellent products, customer value, and sound financial performance.

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Group Award Plan 22

In 1994 CCAD designed a bonus plan, the Group Award Plan, to replace the various performance awards. The Group Award Plan was intended to supplement the new teaming initiatives with installation-wide monetary awards recognizing installation-wide performance.

Marketing Program 23

CCAD's Marketing Office developed customer information video tapes, designed to specific customer needs, to inform the customers of the work to be performed prior to the start of production.

Myers-Briggs Type Indicator 23

CCAD has implemented the use of the Myers-Briggs Type Indicator analysis intended to improve inter-depot communications, and foster and strengthen teamwork. The Myers-Briggs Type Indicator is the first in a series of courses the Depot is using to train personnel for new work environments.

Seven Habits of Highly Effective People 24

CCAD has implemented the training of Stephen R. Covey's "Seven Habits of Highly Effective People." This training is being conducted to help foster and strengthen teamwork. This effort is expected to create a workforce that will be productive and flexible enough to achieve a 30% reduction of costs at the Depot.

Point of Contact

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Section 2

Best Practices

Test

Analytical Investigation

The CCAD Analytical Investigation Branch (AIB) provides the unique service of accident investigation involving rotary wing aircraft and Army fixed wing aircraft. The AIB also investigates crashes involving Navy and Air Force rotary wing aircraft.

The AIB consists of investigators, mechanics, and laboratory personnel (chemist, materials engineer, and materials engineering technician). It is the investigator's responsibility to lead the process and prepare a report that outlines the investigating team's findings/conclusions, recommendations, and any material analysis prepared by the laboratory in support of the investigation. The AIB's workload can be divided into four categories:

- Accident Investigation
- Equipment Inspection Reports (EIRs)—failure analysis of Army equipment that malfunctions in the field
- Army Oil Analysis Program—periodic analysis of oil samples for evidence of wear metals
- Engineering Investigations (EIs)—failure analysis of Navy and Air Force equipment that malfunctions in the field.

The AIB handles 250 to 300 projects per year. In 1997, the AIB processed 107 EIRs, 77 EIs, 76 Army Oil Analysis Program support items, and 18 major mishaps. Major mishaps are those that require the investigation team to visit the crash site. The AIB's location at CCAD allows it the unique capability to test components and utilize equipment peculiar to rotary wing aircraft on demand.

The AIB has assisted several government agencies, including the National Aeronautical & Space Administration, with accident investigation and failure analysis by assisting with the investigation of the Challenger mishap. The AIB has also assisted the Federal Aviation Administration, the Border Patrol, the Forestry Service, and the State Department. The AIB has investigated mishaps involving ground vehicles, particularly the M1A1 tank and the Civilian Utility Transportation Vehicle.

The AIB has begun to take several steps to automate the investigation process as much as possible:

- Each investigator has been equipped with a laptop computer which has reduced the time required to complete a field investigation from 14 to 10 days.
- Purchase of an optical jukebox which allows archiving old files on CD-ROMs improving search capability.
- Plans to establish an intranet allowing investigators to access data files from remote sites.
- An initiative to put a field workbook containing information on each aircraft onto a CD-ROM, which will allow the investigators to take the information to the crash site. The goal is to have a CD-ROM for each aircraft and engine. The CD-ROM for the Apache has been completed.

The AIB has established itself as the Department of Defense (DoD) expert in analysis of mishaps and failures of rotary wing aircraft and components.

Bearing Shop

CCAD has a state-of-the-art bearing shop for acceptance inspection of new bearings, and for repair of used bearings for aviation use or for other purposes. The majority of the work in the bearing shop is for aviation use. In 1997, 28,000 used bearings were processed through the shop with 74% of the bearings being reclaimed for use. The 1997 cost savings for reclaiming bearings versus purchasing new bearings was $9.8 million with a cost avoidance of $7.5 million.

Approximately 13,000 new aviation bearings are checked in the facility per year to ensure that the bearings are functional and meet all requirements before use. Approximately 1% of the new bearings fail to meet the requirements. Each bearing is assigned a traveler for traceability upon receipt. The bearings are weighed, then cleaned, disassembled, and checked for all critical dimensions. New bearings are never handled without using gloves to prevent corrosive skin oils from contaminating the bearing. The bearings are cleaned and then reassembled and process packed in a clean

room environment. Each package contains a label printed with all critical measurements and the complete identification of the bearing.

Bearings that are used, or new bearings that fail to meet the requirements, may be reworked by honing the races up to 0.0003 inch if necessary, and installing new balls or rollers. The bearings are cleaned and then reassembled and process packed in a clean room environment. Each package is marked with the same information as a new bearing, and also contains the number of operating hours on the bearing.

Bearings are typically processed through the facility in a three-day window for normal priority items, and in one day for high priority work. Less than 0.1% of the bearings are ever returned by the customer due to the bearings not meeting requirements. An example of one success story is when a customer was grounding some of its aircraft due to shortages and non-availability of one bearing, due to problems with the stock on hand of 664 bearings. The bearing shop was called on to assist in the problem. The shop was able to reclaim approximately 500 of the bearings in a two-day period and prevented the grounding of the aircraft.

The personnel in the bearing shop are rotated every ten weeks to a different job in the shop so that, at the end of five-and-one-half years, everyone is familiar with all of the processes performed. The facility can process bearings ranging in size from miniature to large (three feet).

Thread Measurement Process

CCAD uses a laser thread measurement machine to improve inspection methods. In 1993, CCAD was tasked to perform repairs on the UH-60 spindle assembly. One of the requirements was to perform an inspection of the critical thread characteristic on the spindle, the spindle nut, and the retaining rod. Because failure of a spindle assembly results in catastrophic failure of the aircraft, it is critical that the inspection be done accurately without adversely affecting the integrity of the assembly.

The inspection requirement prevented CCAD from using standard gages to measure the critical root radius because of the potential to scratch the surface of the assembly. The spindles are made from titanium; therefore, scratches on the surface can progress to stress cracks on the part. CCAD used pitch micrometers to measure the pitch diameters; optical comparators to measure the root radius; and lathes to measure the helical deviation. This process took approximately 30 minutes to conduct one inspection. Each spindle must be inspected twice, resulting in one hour total inspection time per spindle. CCAD repairs approximately 500 spindle assemblies per year. Using the old inspection method, the accuracy of the results depended heavily on the skill and experience of the operator, and documentation of the results was questionable.

In 1996, CCAD purchased an Aperion Laser Thread Measuring Machine for a total cost of $120,000. This price included the cost of special fixtures required to mount the spindle on the machine and all required software. The laser thread measuring machine is computer controlled, which results in a faster, more accurate inspection and provides a means of standardizing documentation methods. Complete inspection of the spindle can be accomplished in 14 minutes using the laser machine. Besides the 50% reduction in process time, the software purchased with the laser measurement machine will immediately inform the operator if any of the measurements are out of tolerance.

By using the laser measurement machine, CCAD does not incur the cost of storing, maintaining, and calibrating gages. These gages must be kept in a controlled environment and calibrated yearly in a certified laboratory, which costs approximately $80,000. The laser thread measurement machine is calibrated daily using a standard purchased from the factory. The machine also undergoes yearly calibration by a factory representative.

After using the laser thread measurement machine, CCAD detected a high failure rate in the retaining rod. The repair process has been modified to include 100% replacement of these rods. The laser thread measurement machine provides CCAD with a fast, accurate inspection system that can be used to conduct measurements to a variety of thread standards.

Production

Advanced Metal Finishing Processes and Facility

CCAD operates a new metal finishing facility, one of the most advanced metal finishing facilities in the DoD (Figure 2-1). The new metal finishing facility consists of 18 process lines with 25 processes including electroplating, conversion coating, anodizing, metal stripping, aqueous cleaning, passivation, aluminum vacuum coating, nitrogen implantation, stress relief, and organic finishing. The previous

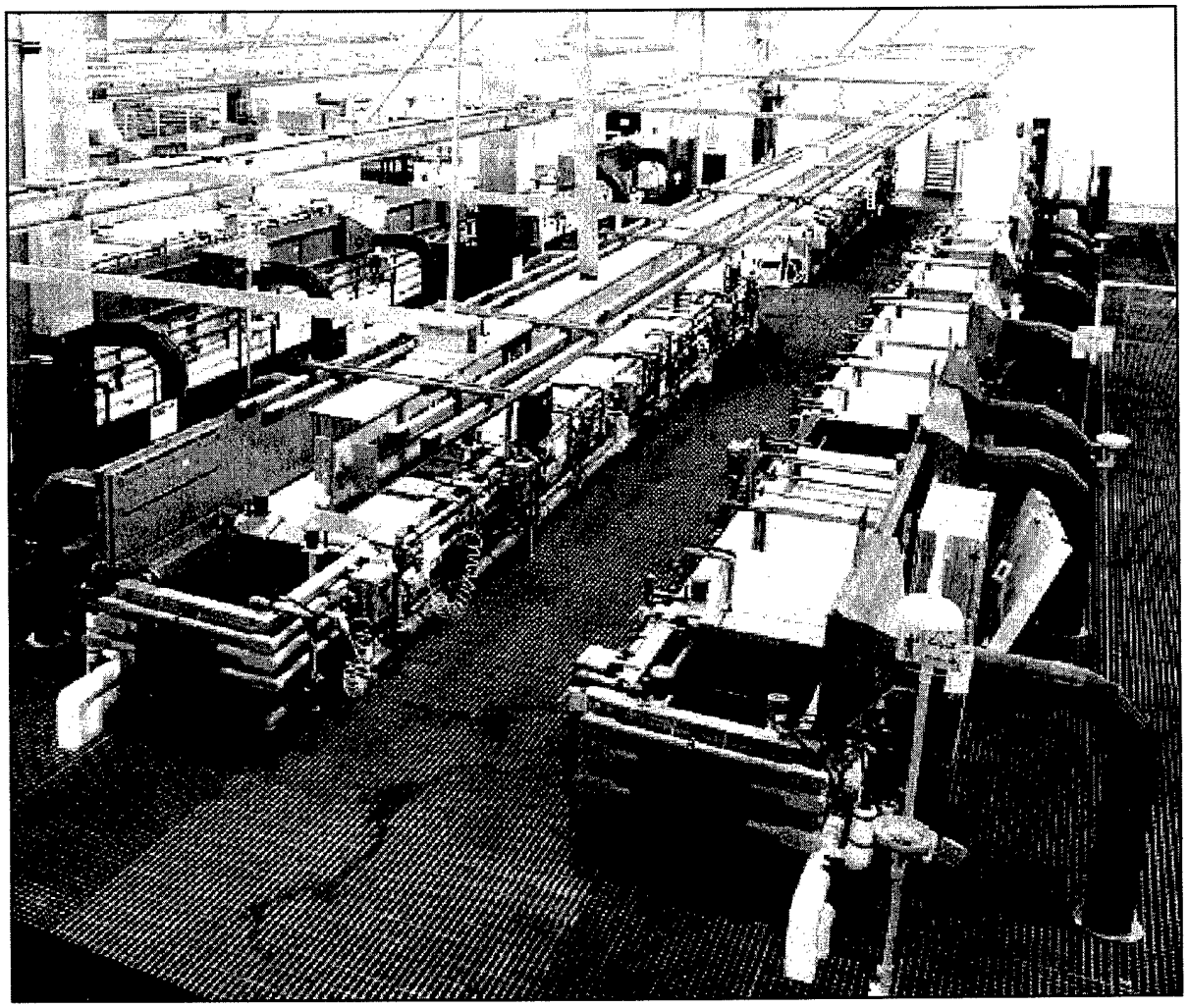

Figure 2-1. Advanced Metal Finishing Facility

plating facility was an old structure, outfitted with small tanks and uneconomical scrubbers and ventilation systems. CCAD's Advanced Metal Finishing Facility's new design and modernized equipment have reduced operator labor by 20%, water consumption by 90%, and hazardous waste disposal by 90%.

The new metal finishing facility has greatly improved safety and productivity and has provided the capability for environmental compliance. Safety has been improved by adequately segregating and storing cyanides, automating the black oxide process, and providing enhanced ventilation for fume control. Processes became more effective by using straight lines for material flow, sizing tanks for new weapon systems, and providing better laboratory support. These improved efficiencies resulted in increased productivity and expansion capability. Environmental compliance was facilitated as follows:

- Ground water protection was enhanced by closed loop water usage. By constructing the metal finishing processes on the second floor and the wastewater treatment and storage system on the first floor, the risk of a hazardous waste spill was essentially eliminated. Furthermore, there were now four layers of spill protection, and all gravity drains from the building were disconnected.
- Water reuse resulted in substantial water conservation. Deionized water was produced on-site and spray rinsing/double and triple counter current rinsing were used.

- To comply with air quality requirements, a mesh pad was used for the chrome scrubber, and acid/alkaline scrubbers were used. For blasting operations, a centralized dust collection device was used. A backup generator was installed as an emergency response measure.
- Waste minimization was implemented. Concentrated and diluted waste waters were segregated, and a diluted waste water stream was continuously treated. The concentrated waste water was treated as a batch.

The advanced metal finishing facility has provided enhanced safety, improved productivity, and environmental compliance capability. New technology such as aluminum vacuum coating shows good promise; however, it will take some time until it is universally accepted in the DoD system. Lessons learned in operation of this facility include:

- Too many alarms were designed, and only critical alarms should be audible.
- A centralized computer for heating, ventilation, and air conditioning is needed.
- No air agitation of chrome plating tanks is needed.

Depot Maintenance Hazardous Material Management System

CCAD pioneered the Depot Maintenance Hazardous Material Management System (DM-HMMS), which is often called a hazardous material pharmacy program. DM-HMMS is more than a relational database; it is a basic change in the way the Depot does business. Prior to DM-HMMS, CCAD's production controllers did not have a master list to gauge inventory when they ordered chemicals and solvents used in the aircraft overhaul process. Consequently, these materials were ordered in excessive quantities, creating more inventory than necessary and requiring much more disposal than what is now required with the new hazardous material management system.

With the DM-HMMS fielding in November 1993, CCAD was able to manage all inventories of hazardous materials, operating like a pharmacy system that is designed to control authorized access and ensure proper issuance of only the amount necessary. Consequently, hazardous material acquisition was substantially reduced.

DM-HMMS has the capability to print all material safety data sheets, and identify and track hazardous materials and their users. Hazardous materials are issued at only 10 issue points in CCAD. With digital scale and bar code scanner, issue clerks track the amount of chemicals used, their remaining shelf life, user identification, and their location on the Depot. DM-HMMS also has the capability to print environmental compliance reports.

Lessons learned from this project include:

- Constant attention to the program is needed. The data must be updated and validated, and continuous process improvement is needed.
- Continuous training of HMMS operators and users is needed
- Integration of this system with another agency's (e.g., Defense Logistics Agency) production management information system will be needed in the future.

CCAD data showed a reduction in hazardous material acquisition of approximately $6.2 million from 1994 through 1997.

Plastic Media Blasting Process

CCAD's main mission is to overhaul, repair, and modernize military (Army, Navy, and Air Force) helicopters. Since May 1983, CCAD has successfully used plastic media blasting (PMB) for helicopter airframe paint removal. Prior to PMB, aluminum airframes were chemically stripped and hand sanded. This process was labor intensive, requiring many safety precautions; messy; slow on removing epoxy paint; and expensive because of the control and disposal of the waste products.

CCAD is equipped with a large facility for blasting a complete helicopter, and smaller blasting cabinets for blasting the smaller size materials and components. Operators who use PMB have knowledge about media requirements and performance, equipment maintenance requirements, and the material being blasted (e.g., metal type and thickness). Operators are trained and annually certified for PMB. At CCAD, only Type III and Type V media are allowed to be used. PMB process parameters include media flow, nozzle pressure, angle of attack, cleanliness of surfaces to be blasted, media type (e.g., hardness, material type, etc.), and material surface map.

CCAD learned that PMB works; optimization and long-term planning among PMB, chemical stripping, wheat starch media blasting, baking soda blasting (to be tested), and high pressure water jet stripping will be needed; more study on ergonomics (e.g., holding device, platform, lighting, visibility, room to move) is still needed; vendor should certify material quality; a Quick Test for Quality of Media

(Mil-P-85891) will not be able to clearly identify poor performing media; performance testing is time consuming; and acceptance of the process took time.

Benefits of PMB include man-hour savings due to high efficiency compared with manual sanding; improved work safety; reduced facility maintenance; and reuse of media and reduced waste disposal costs by eliminating hazardous chemicals.

Pollution Prevention

CCAD has proactively complied with the United States Environmental Protection Agency and the State of Texas environmental regulations. The Depot's pollution prevention (PP) program has been a key environmental program, which helped CCAD attain full compliance with environmental requirements. The PP program has also provided the Depot with operation and maintenance cost savings.

CCAD has been a leader in the DoD PP program. CCAD started the PP program in 1988 when the plastic media blasting facility was placed in operation. Since that time and as of January 1998, 15 PP projects have been completed, and six more projects are planned for completion no later than 2002.

The main focus of CCAD's PP program has been in the area of reduction/elimination of ozone depleting substances/ozone depleting compounds, cleaning solvent elimination, plating waste minimization, and cadmium plating reduction/elimination. In addition to PP projects, many of the production modernization projects had pollution prevention considerations.

CCAD is an active participant in the U.S. Army Industrial Operations Command (IOC) Centers of Technical Exchange (CTX) Environmental Programs. CCAD is the IOC CTX for plating and for solvent replacement. Table 2-1 shows CCAD's PP projects. Detailed information on each individual project technology and cost saving data are available from CCAD.

Table 2-1. Pollution Prevention Projects

Titles	Project Costs	Implementation Year
Plastic Media Blasting for Airframe	$800K	1988
35 Plating In-tank Filters	$35K	1991
Electrodialysis System	$340K	1992
New Pre-treatment	$550K	1993
Ultrasonic Cleaners	$300K	1993
Freon Recovery Unit	$15K	1993
Aqueous Cleaner	$617K	1993
Ion Vapor Deposition of Aluminum (Cadmium Replacement)	$1500K	1993
Wastewater Plant Rehabilitation	$500K	1994
Plastic Media Walk-in Booths	$244K	1994
High Pressure Water Jet Stripper	$900K	1995
Laser Paint Stripper	$900K	1995-1998
Wheat Starch Media Paint Stripper	$370K	1996
Advanced Immersion Cleaner	$250K	1997

Programmed Depot Maintenance Scheduling System on the Web Page

CCAD utilizes the World Wide Web to distribute information to customers. The Programmed Depot Maintenance Scheduling System (PDMSS) was implemented at CCAD in October 1993 as a result of a Joint Logistics Systems Center DoD-wide initiative. The benefits of PDMSS include providing program management techniques and scheduling tools to improve CCAD's competitiveness in the aircraft repair industry. The PDMSS also provides a means of obtaining the status of the repair process on any particular aircraft. This information is updated daily based on input from CCAD work centers.

Prior to implementation of the PDMSS web page, CCAD would generate reports to respond to customers' inquiries concerning the status of particular aircraft. These reports were then faxed to the customer from CCAD. This method required the customer to call CCAD during business hours, and to have access to a fax machine in order to receive the data.

CCAD developed the PDMSS Web Site as a means of providing customers access to aircraft data at any time from any where in the world. Because of the nature of the data, all information is stored on a secure server, and access is password protected. CCAD modified the daily update procedure of the PDMSS to include sending the updated information and reports to the Web Site automatically. This process provides the customer with up-to-date information for each aircraft. The Web Site also provides the customer with points of contact for all aircraft program lines. By utilizing the World Wide Web, CCAD was able to improve its responsiveness to customers' needs, from days to real time.

Wheat Starch Abrasive Media

CCAD's primary mission is to overhaul, repair, and modernize military (Army, Navy, and Air Force) helicopters. Since May 1997, CCAD has successfully depainted helicopters' composite material surfaces using wheat starch based abrasive as a blasting material. Before wheat starch based abrasive media was used, hand sanding was commonly used for composite material surface depainting. Plastic media blasting was allowed with limitations for some composite material depainting operations. CCAD uses proprietary starch media, off-the-shelf wheat starch media blasting equipment, and recycling equipment.

The newly built starch media blasting facility is not yet being used 100% of the time yet; however, more depainting work is expected at the facility. There are no military specifications or criteria for the performance of wheat starch based abrasive media blasting on composite material surfaces. However, the Society of Automotive Engineers is in the process of developing Aerospace Standards for Starch Media Abrasives. Operators who use wheat starch based abrasive media should have knowledge about media (e.g., materials and geometry), maintenance requirements for equipment type and conditions of coatings, and receive training to perform equipment maintenance.

CCAD learned that wheat starch based abrasive media blasting works; the facility must be kept dry at all times; metal mesh floor is used to keep paint peelings out of equipment; after blasting, resealing of the blasted surface is necessary; and special gages are needed to measure paint thickness on composite material. Wheat starch based abrasive media blasting is faster than hand sanding, and causes less damage to the composite material surface than plastic media blasting. Benefits of using wheat starch media include cost savings from efficient depainting compared with manual sanding; minimum damage to fibers; less paint adhesion failures; and reuse of media (several times).

Management

Adaptation of Monarch for Depot Use

With the ever increasing time and money spent generating paper reports, CCAD saw a need to improve Depot effectiveness. To that end, a commercial-off-the-shelf software package, Monarch for Windows, was purchased from Datawatch Corporation which enabled CCAD to electronically store and retrieve listings from its file server.

Daily inputs are electronically sent to CCAD's Mega Center mainframe in Huntsville, Alabama where processing occurs. The following morning, the reports are ready for viewing by the user. Monarch looks at the listings electronically and automatically performs a compression of the file for increased speed in bringing it up. Monarch has the capability to filter, sort, and perform calculations. The software can export the report to MS Excel, MS Access, FoxPro, Freelance or Paradox. Monarch has the capability to perform searches, extract information from specific fields, move fields, and sort specific information in the order requested.

Monarch has been in use at CCAD for the past three-and-one-half years. The package was initially purchased for less than $400, and CCAD has more than recouped its investment over the years. It is estimated that in 1997, $75,000 to $80,000 was saved in printing costs with the use of Monarch. The goal for 1998 is to cut printing costs 25% to 50%. CCAD also saved money by reducing the time it takes to reconcile listings. The software is easy to use, it is inexpensive, and it works.

High Performance Training

In recent years, CCAD has been developing and putting in place action-oriented initiatives and training programs designed to give every member of the command the skills and knowledge necessary to achieve high levels of performance, characteristic of a High Performing Organization (HPO). The goal is to create an organization with the understanding and will to focus on higher performance. HPOs consistently meet or exceed customer expectations for quality, value (fast delivery), and financial performance within a constantly changing, dynamic environment. CCAD is motivated to become an HPO by the need for survival, pride, and to achieve a higher moral purpose.

The HPO model depicted in Figure 2-2 was developed by Dr. John W. Pickering of the Commonwealth Center for High Performance Organizations, Inc. The leadership of the organization defines the functions, philosophy, and form expressed in terms of the vision and values of the organization which define the strategy, structure, and systems of the HPO. To achieve this level of performance, it is necessary to build a mechanism for change. This mechanism

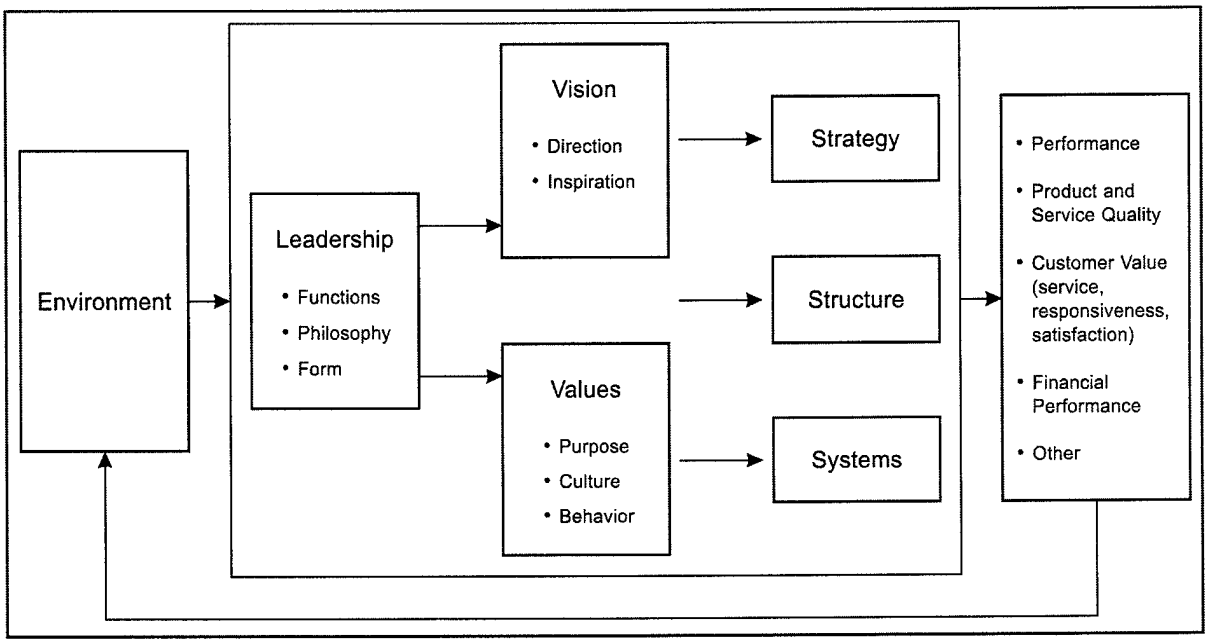

Figure 2-2. High Performance Organization Model

must work effectively at all levels in the organization—from the top managers, through all the naturally occurring groups, down to the individuals.

CCAD built this mechanism on a series of interconnected programs that support personal growth and continuous improvement in the organization. It begins with the training and application of the Myers-Briggs Type Indicator (MBTI) system. This is taught and used in a variety of ways for such processes as career development, team building, and problem solving. It forms the foundation for other training and processes including the application of Dr. Stephen R. Covey's Seven Habits of Highly Effective People, Honesty, Ethics, Accountability, Respect, Trust & Support (HEARTS) training, and formal HPO training. All members of the command will receive two-and-one-half days of MBTI training, three days of Seven Habits training, two days (initially) of HEARTS training, and three days of HPO training. The net result of these programs is improved teamwork, more focus on improving processes and how to do it, clear direction and leadership from top management, much better communication at all levels, and people equipped to deal with change. Individually, these programs are common to many organizations and are often applied and forgotten as fads. CCAD has linked them together in a comprehensive and well executed process to give all its employees the capability to make CCAD an HPO.

Operation Paint Brush and Operation Christmas Spirit

CCAD participates in a greater Corpus Christi area community program, Operation Paint Brush. This is a program in which several community organizations go out and paint the exterior of area houses owned by elderly or handicapped citizens. CCAD is assigned a number of houses of qualified participants and sends a team of 15 to 30 employees to scrape and paint the exterior of the house. The team also performs minor structural repair and cleans up the yard of the premises when the job is finished. Depot personnel are assigned to specific teams, which in turn are assigned to specific houses. Most of the work is targeted for the June time frame. The Depot has participated in the program since 1985, and to date has painted approximately 280 houses. Local merchants donate the painting supplies, while local organizations like CCAD supply the manpower. This program has been a tremendous success for the community and Depot personnel who donate their time, while the homeowner saves approximately $2,000 for the job.

The Depot also founded a project called Operation Christmas Spirit. This program provides gifts and fruit baskets to elderly community residents in 16 area nursing homes. The gifts are provided to approximately 2,500 area residents. The Depot raises money through various bake sales to buy the gifts. A

Depot employee is assigned to each nursing home and given the names of the elderly. That person ascertains what type of gift they want or need, buys the gift, and delivers it during the holidays. This program was founded solely by CCAD, and is a tremendous community relations program for the Depot.

Strategic Planning Process

CCAD developed and put in place a disciplined and well-implemented strategic planning process. Previously, the Depot's strategic planning was difficult to integrate into the complex nature of Depot operations. Very little external information regarding the position of the Depot in the industry and the competitive environment was obtained in developing strategies. As a result, common business objectives had been sporadic.

In the early 1990s, the Depot began to develop marketing plans. CCAD soon realized that it was necessary to develop a strategic plan before a meaningful marketing plan could be accomplished. The foundation of the strategic planning process developed by beginning with the best of past efforts, studying external forces (e.g., the Government Performance and Results Act of 1993, and the IOC Strategic Plan for Year 2001 requirements), and focusing on CCAD's customers and the business environment.

In 1997, CCAD began to implement a strategic planning process for the years 1998 to 2001. A formal Strategic Planning regulation was put into effect which fully documented and defined the process. Figure 2-3 shows the process flow for strategic planning, implementation, and management. Strategic planning begins with identifying the beginning and ending periods of the planning time frame. It involves assessing the Depot's current situation, its strengths, weaknesses, opportunities, and threats. Strategic planning includes reviewing the mission and any anticipated fiscal or resource constraints that are expected over the planning period which may stand in the way of achieving the mission. In the process, the leadership team visualizes what the Depot wants to achieve (its vision) by the end of the planning period. The steps in a strategic

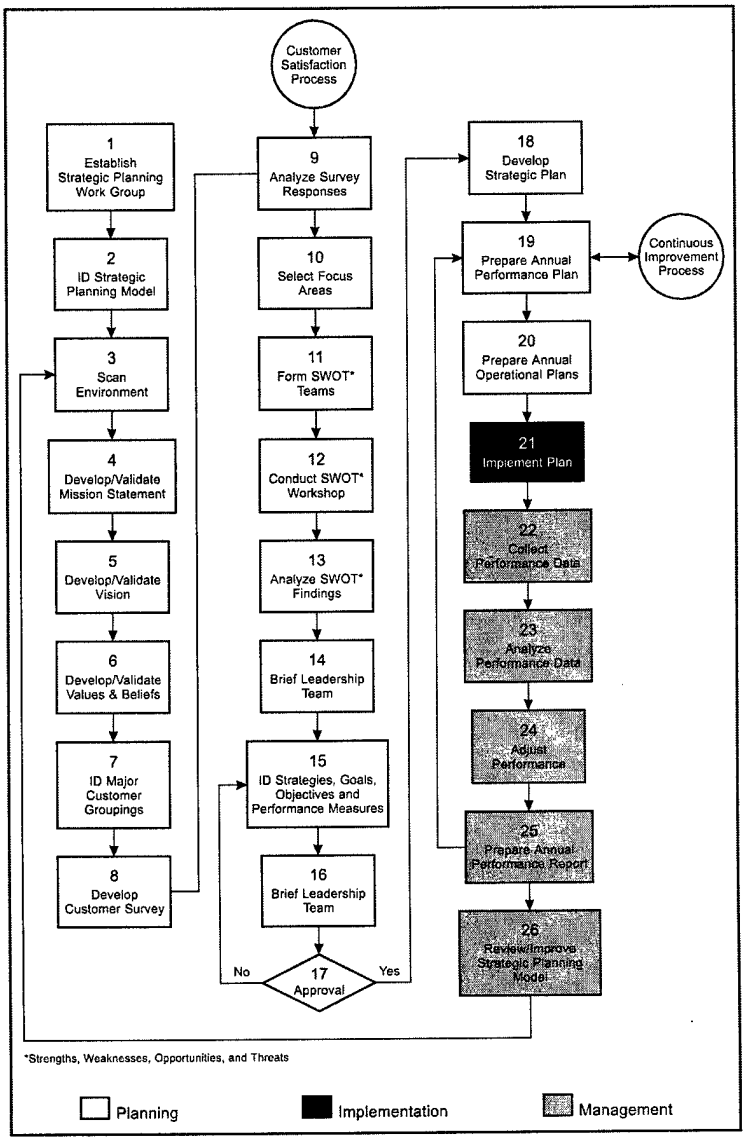

Figure 2-3. Strategic Planning, Implementation, and Management Process

planning cycle result in strategies, goals, objectives, and performance measures to achieve that vision for the future. Strategic planning involves all Depot members to be successful and effective. Its success is measured ultimately by the Depot's customers.

The planning process was kicked off by forming teams which included a Strategic Planning Working Group, the Depot's Executive Leadership Team, and five Strengths, Weaknesses, Opportunities, and Threats (SWOT) Teams. These teams worked in parallel to develop, customize, and implement the 26-step process for CCAD. A Customer Survey was taken to get honest input from the Depot's customers

as part of the overall environmental scanning process. A six-question telephone survey was conducted with 20 customers to which 100% responded. The three most important items identified by customers were 1) reduce cycle time; 2) improve communications; and 3) adhere to the customer's statement of work without compromising quality and safety.

Each of the five SWOT teams addressed a specific area: Market Knowledge, Human Resources, Operations, Financial, and Management Information Systems (MIS). The MIS team received the input from the others to develop an Information Strategy that supports the other four areas. The teams developed five strategies: Planning, Customers, the Workforce, Information, and Cost. Each of the strategies has well defined and clearly specified goals and objectives. Performance measures are being fine-tuned.

CCAD is in the process of implementing the strategies. The Strategic Planning Handbook for 1998 to 2001 is currently being printed and will soon be distributed to all Depot employees (March to April 1998). The Annual Performance Plan for 1998 is being developed by the Executive Leadership Team and will be distributed with the handbook. The strategies are being implemented through the Depot's Continuous Improvement Process involving communication, coaching, and ownership to all levels of the command. This process is increasing communication across the entire organization. The primary focus is on the customer. The process requires increased teamwork and creativity. A key to success has been coordination at all levels. The process has provided a strategic planning and management roadmap for CCAD, and has given the Depot a tool with which it can control and manage the course and pace of change.

VISA Credit Card Software

In the early 1990s, CCAD initiated a pilot purchasing program using the VISA credit card. Purchasing items and services under $2,500 using the credit card has since become a cornerstone of acquisition reform in the DoD. The Army is now a leader in implementing this program with a 1998 goal of 90% of all purchases under $2,500 being made with the International Merchants Purchase Authorized Credit Card, VISA credit card. CCAD's program is very close to meeting this goal. A VISA database software package is installed on each credit card holder's personal computer to create purchase requests, provide monthly summaries, and maintain complete buying histories for the individual card holder.

Prior to the implementation of the credit card program, the cost to manually prepare a purchase request in hard copy, process it through the approval cycle, send it to the contracting office, and have a purchase order issued was approximately $200 per line item. This was a time consuming process with a great deal of generated paperwork. Lead times for purchasing simple items were a continual concern. In the early 1990s, the credit card program began as a method of making this process more efficient. Through use of the credit card, purchases were made without delays, and the cost per line item purchased was reduced from $200 to $48, amounting to a first year savings of approximately $800,000. Estimates of savings for recent years approach $1.5 million due to the increase in credit card use.

CCAD has locally-developed software which eliminates the need to generate hard copy purchase requests, retains the purchase records for automatically generating monthly reports, and is available for summary queries. This software is installed on each card holder's desk computer and is used to enter purchase request data, perform specialized queries, and develop a monthly summary billing report and detailed purchase report. These two reports can be reconciled monthly for total dollar value purchased for the month as a check for accuracy. Hard copy paper is used only to document supervisor approval of the purchase, and to send summary reports to accounting for consolidation to the Defense Finance and Accounting Service for payment and reconciliation with the VISA monthly invoice. Approximately 125 cardholders use this system to process their purchases, maintain records, and generate reports.

Wellness Program

Prior to January 1997, the CCAD Wellness Program did not exist. Personnel in the Counseling Center began to recognize the need for a Wellness Program due to such issues as the aging workforce and the high number of back and leg injuries. The Counseling Center administered programs such as drug testing and employee assistance. Most employees stayed away from the center due to the negative connotation associated with its programs. But Center personnel recognized the need to provide assistance to a greater percentage of CCAD

personnel, and began to research how to implement a wellness program. Research showed that most of the activity in developing effective wellness programs was being accomplished in private industry. CCAD benchmarked effective work site wellness programs in industry, studied the benefits of work site wellness, and examined the range of things the Depot could do within regulatory guidelines.

In November 1996, command approval was given to implement a wellness program. The objective of the program was to provide employees with the opportunity to develop mentally and physically to meet new challenges and make responsible choices toward a balanced, healthy lifestyle. This objective also served the overall business objective of providing management with a workforce composed of productive, healthy people.

In January 1997, the Counseling Center changed its name to the Wellness Center. The name change alone made a big difference in the interest in the programs provided by the Center. The Center began focusing on a number of positive programs to improve the lifestyle and well being of the CCAD workforce. Programs included working with the local health clubs to obtain corporate rates for CCAD personnel. The Center contracted with a local hospital to conduct a heart risk study in February, April, and July 1997. Nearly half of the employees at the Depot voluntarily participated in the study. The study showed high percentages of conditions that placed employees at risk for heart disease such as high cholesterol, high blood pressure, and high blood sugar. More than 85% of employees participating in the study were above their ideal weight. As a result of this study, new initiatives such as smoking cessation classes and weight management programs were implemented. Voluntary drug testing was implemented and received broad employee support. Other programs included a walking program with progress charts for each participant and certificates of achievement. Stress management classes were offered as well as family assistance programs that were expanded to include other family members.

Each month, the Wellness Program develops a theme such as nutrition, alcohol awareness, safety, and breast cancer that helps focus attention on important topics. The Center provides videos and classes on these themes and has been receiving high levels of response and interest in the programs. These themes are coordinated with the Safety Office to complement monthly safety themes.

Since establishing the Wellness Program, the Depot has seen improvements in morale, employee energy, creativity, productivity, and health. Fatigue, absenteeism, injuries, medical costs, and workers compensation have been reduced. Metrics are being developed and used in all these areas. A new heart risk study is scheduled to follow-up and compare data from the previous studies, and monthly classes are being continued in stress management, smoking cessation, and weight management. Evaluation criteria for the program has been developed to measure issues such as absenteeism and tardiness, injuries, medical costs, and workers compensation costs.

Section 3

Information

Production

Apache Helicopter Pre-Modification Process

The Army has begun a remanufacturing effort to modify up to 758 AH-64A helicopters to the AH-64D configuration. CCAD provides depot support to Boeing in conjunction with the remanufacturing of the AH-64A helicopter. The Boeing Company-Mesa, (formerly McDonnell Douglas Helicopter Systems) is the original equipment manufacturer of the AH-64 helicopter. Boeing pre-modifies and remanufactures the AH-64A into the AH-64D. CCAD provides depot support to the remanufacturing effort for crash damage, experimental and Category B (Trainer Aircraft) entering this program.

Once an aircraft designated for remanufacture has been inducted at CCAD, it is completely disassembled, and pre-shop analysis inspections are conducted. CCAD inspects and evaluates approximately 3,000 parts from the AH-64A configuration per the Input Configuration Document. The parts are then either repaired, demilitarized, sent to the AH-64A supply pipeline, sent to Storage, Analysis, Failure Evaluation, and Reclamation (SAFR), or cleaned and packed for shipping to Boeing. CCAD also repairs, modifies, and prepares the fuselage for shipment to Boeing, including applying any outstanding modifications and making any necessary repairs. The airframe and components are packaged as a kit and sent to Boeing to begin the remanufacture process.

This program is still in the early stages at CCAD. Some of the challenges being faced include inventory control (which CCAD chose to automate immediately), parts accountability, scheduling, and reducing turn-around time. Successful execution of this program required CCAD to establish and maintain an open communication system with Boeing to facilitate the exchange of critical information. Through weekly phone conferences, CCAD is informed of current document changes and any new requirements which allow the Depot to respond to these changes in a more timely manner. The capabilities used on this present Apache program can be leveraged to support similar aircraft remanufacturing programs in the future.

Material Management Process Improvement Initiative

Material management at CCAD involves the management and supply of all material required to support CCAD's core business processes of overhaul and repair of aircraft and components. The material management process improvement initiative is aimed at schedule conformance—meeting production schedules by getting the right material, to the right location, in the right condition, and on time.

A study performed by Coopers and Lybrand over a five-month period charted each Directorate's labor activities required to get material to the production floor. Activities included requisitioning materials; shipping and receiving; expediting materials; storing, managing and maintaining inventory; and distribution. The study exposed the magnitude of costs associated with the current material management process. This revelation justified additional investigation of the process and an effort to reduce cycle time and the associated material management activity costs.

A project team was established and a multi-phased approach was adopted. The team's first step was to establish a project work schedule. The team then developed a full understanding of the "As Is" material management process and developed "To Be" scenarios. By analyzing the "As Is" versus "To Be" models, the team developed improvement recommendations and a plan to implement the recommendations.

The analysis methodology included documentation of a high-level conceptual map of the material management process. After the conceptual map was completed, the team developed a very detailed process flow diagram. Using this diagram, the team documented Route By Walking About (RBWA) segments of the process flow and identified specific tasks associated with each RBWA. Twenty-five RBWA segments were identified, described, and charted. The gathered metrics for each RBWA was analyzed and improvement recommendations were developed. High cycle-time contributors included delays from labor intensive paperwork; performance of many non-value added steps; waiting for drawings, information, and data; personnel not communicating in a timely manner; and non-responsive vendors.

Because the material management process is an intricate process woven throughout all Depot activities, a process owner was established. The process owner is the single point of contact responsible for the entire material management process. The process owner reports to the Depot's Civilian Executive Assistant and has authority to cross Directorate lines to resolve issues. A project manager was also identified, with the responsibility of coordinating the project with other improvement initiatives, supervising implementation, and maintaining the project work plan. A subject matter expert was assigned as the lead person responsible for implementing each specific recommendation.

The material management initiative is justified and its approach is sound. To date, 34 recommendations have been selected for action and 14 recommendations have been implemented since December 1996. Criteria for prioritizing recommendation implementation is based on those recommendations that have the lowest risk and cost, and the most potential benefit to the Depot. Accumulative impact has not yet been measured. The "To Be" goal of the Material Management Improvement Initiative is a 70% reduction in cycle time for the flow of material and supplies.

Powder Coating Technology

CCAD has installed a powder coating system that is being used to apply corrosion and fretting resistance coatings on selected, approved aerospace components. Powder coating technology is an alternative method to liquid coating protection for materials. The technology uses no solvents, and as a result, reduces the pollution of the environment from Volatile Organic Compounds (VOCs).

The existing industry-wide liquid-coating process uses paints that contain VOCs which are detrimental to the environment and require special processing equipment and facilities to protect the paint operator. The process is equipped with a spray booth containing an exhaust for the release of the VOCs, filters to collect over-spray, explosion proof equipment, and fresh air respirators for the operator's safety. Parts are typically sprayed with a primer and a topcoat containing high VOC solvents. Not only is the current industry process unfriendly to the environment, it presents a health hazard to the operator and results in high maintenance costs.

CCAD began exploring powder coating technology because of Environmental Protection Agency environmental laws. In 1995, a batch booth system was installed and brought into operation to apply corrosion and fretting resistance coatings on selected, approved aerospace components. The process uses a powder coating. The powder is usually held in a hopper that is bombarded with dry and clean air, making the powder act like a fluid. This powder fluidization allows for easy flow. The powder is then pumped from the hopper through an electrostatic system where it is charged and sprayed onto a grounded part. Because of the electrostatic charge, the powder clings to the part. Once the part is fully coated, it is routed to an oven for curing. A cool-down period is usually required after parts are cured. Proper powder cure is usually obtained when the part has been properly pre-treated (cleaned and etched), properly grounded, and the powder is dry and clean. Booths are equipped with over-spray filters (some with reclamation capabilities). Part application dictates the type of powder material used. Typical parts that CCAD is planning to coat are magnesium, aluminum, and steel aerospace components. With powder coatings, it is possible to control the thickness by controlling the amount of charge applied.

CCAD is pursuing powder coating technology to augment its other efforts to preserve the environment. Currently, CCAD has a turn-key contract to implement an automated production line to powder coat powertrain components. This system is scheduled to be in operation by August 1998. In addition, CCAD is currently in the process of testing powders to be used on many powertrain components that use liquid epoxy coatings.

Shot Peening Program

Shot peening is a technique that propels small diameter shot at the surface of metal parts to induce a residual compressive stress on the surface to enhance fatigue resistance and reduce susceptibility to stress corrosion cracking. In order for shot peening to conform to prescribed Aerospace Material Specification 2432B, a large number of conditions and parameters must be maintained and controlled during the process. Key parameters of a peening operation include shot size and condition, shot flow, air pressure, angle of attack, table indexing, part speed, and peening cycle time. Shot peening produces material performance characteristics that no other processes (e.g., heat treating, annealing, powder coating) can accomplish. Typical materials include titanium, magnesium, steel, aluminum, nickel, and cobalt alloys used in the aerospace

industry. At CCAD, a reliable process can now be performed on parts which rely on the benefits of peening in order to attempt to restore the part to its original component design characteristics.

Prior to July 1996, the peening operation was performed to Mil-S-13165C, which required no process control documentation. Over time, because of operator and system changes and the lack of a formalized operating procedure, the conditions and parameters of the process deteriorated. The equipment was not capable of monitoring and recording key parameters such as table indexing, part speed, and shot flow which were necessary to prevent substandard shot peening of parts. The process was misunderstood, and operators were not familiar with the mechanical effects of shot peening, many thinking it was a cleaning process instead of a beneficial stress and fatigue life enhancement process. Operators did not have the most efficient setup parameters. Maintenance personnel were not familiar with the operation of the equipment; therefore, no preventive maintenance schedule was in place. As a result, customers had little confidence in the process.

In July 1996, the Depot had an opportunity to acquire additional workload from the Navy. The Navy demanded complete process control and conformance with AMS 2432B. This led to the Depot taking steps to change its shot peening operations. The first step was to define the customer's current and future requirements. The shot peening machine was modified with a complete new programmable logic controller, new input/output cards for motor controls and magna valve controllers, incremental encoder for the table, new wheels for the proximity sensors, analog air pressure transducer for the pressure system, digital air quality transducer to control environment, and a touch screen operator interface. Other equipment included a Gateway 2000PC, Hewlett Packard laser printer, SyQuest 1.5GB internal removable drive, Windows NT 4.0 workstation operating system, Office Professional 97 software package, Texas Instruments TiSoft 505 program for the programmable logic controller, National Instruments Lookout Software for the control screens, and Norton's PC Anywhere for remote monitoring by a client computer located in the laboratory. A fully equipped laboratory performs a full set of acceptance tests on all shot prior to use in the system. Statistical process control was applied to track performance and assure process repeatability. Hard copy documentation was made available to the customer.

These improvements have added efficiency and capability to the shot peening operation. The programmer can streamline some of the original program logic to the current system, avoiding the loss of older programs. New code can be written more efficiently. The additional axis of motion and indexing capabilities allow peening parts with complex geometries such as inside surfaces of slots. Programming nozzle and stand off distances are easier due to nozzle location being displayed on a video screen. Training is now being made available, and an operator certification program is being offered. The shot peening operation is now in a position to comply with the latest standards in accordance with AMS 2432B which should open the doors for new business opportunities, both internal and external.

Waterjet Numerically Controlled Machining Center

Prior to 1995, CCAD used conventional stripping and machining operations to remove flame/plasma coatings from aircraft engine parts. These processes were costly, and resulted in the need to dispose of hazardous waste products. In February 1995, CCAD purchased a custom built Waterjet Numerically Controlled Machining Center (WJNCMC). Major components of the system include a six-axis Fanuc S-240F robot with a waterproof robot protective shroud; RJ-series controller; graphic operator workstation; turntable; Jet Edge 57-150 ultrahigh pressure pump with auxiliary hydraulic power unit for nozzle rotation; stripping end effectors; mist collection system; water reclamation system; chiller; and workcell enclosure (Figure 3-1). All system components interface and communicate through the robot

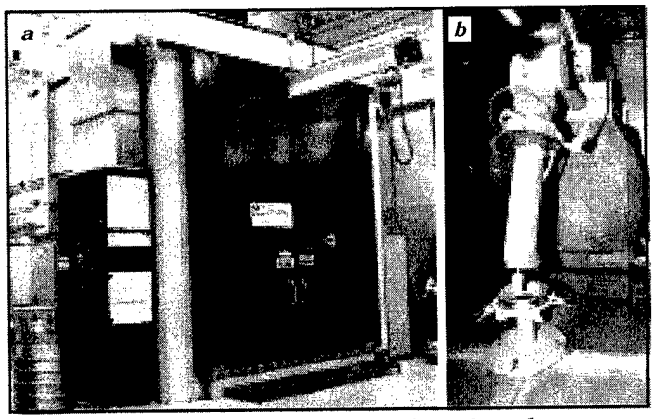

Figure 3-1. a) Waterjet System housing the b) Waterjet Stripper

controller. A deionization system removes positively charged ions and negatively charged particles from the potable facility water supplied to the pump. Deionization minimizes corrosion and system maintenance to the high pressure water pump components and nozzle orifices.

With the water reclamation system, water is recycled for reuse in the stripping operation and all solid materials are collected for disposal. The chiller is used for cooling the potable facility water so it can continuously cool the hydraulic system of the ultra-high pressure pump which minimizes seal degradation and maintenance. The theory of the Waterjet operation is to shoot an erosive force of water at high velocity (Mach 2.5 speed), directed against a coated surface by a rotating nozzle, to remove the coating. Five process parameters are critical for the coating removal: 1) nozzle standoff distance; 2) nozzle angle of attack; 3) nozzle traverse speed; 4) nozzle rotation speed; and 5) water pressure. The robot maintains the first four parameters. The water pressure (25-55,000 psi) is automatically set by operating software or manually by the operator. Coatings are removed by a rapid liquid erosion process. Erosive action at the coated surface occurs in milliseconds. Although there are limitations to the Waterjet system, such as line of sight access and single component processing, the prevention of hazardous waste far outweighs the limitations.

Web Based Data Collection System

The Data Collection System (DCS) is a Web based intranet system, comprised of an Oracle engine with front-end hyper text markup language (HTML) for the comprehensive collection and distribution of data pertinent to all facets of production operations of CCAD. The system is part of an Army IOC initiative to implement Web enabled technology throughout all depots and arsenals to enhance the execution of workload through improved communications, information, standardization, tracking, and control. CCAD was selected in December 1996 as the prototype site to field the first Web based DCS. The initial project prototype took place in July and August 1997.

The system hardware and software being replaced was unable to quickly and accurately status production information, dumb and non-programmable for new initiatives, and incapable of providing easy to use, simplified processes for input and output. The old system primarily serviced financial accounting operations, but was not production and shop floor oriented.

In 1996 and 1997, CCAD procured the hardware and software. The hardware configuration was specific to the requirements established by CCAD, while the software was common across the IOC. Hardware included the purchase of 348 PCS intended for the shop floor, consisting of 166MHz Pentium, 32MB RAM, 17 inch monitors, 16 bit LAN card, 1GB hard drive, 8 speed CD-ROM, 2 MB video card, and Windows NT operating system. Data collection hardware included 265 hand-held Janus 2020 RF Bar Code Readers; five Radio Frequency Network Controllers; five RF Transceivers; and 337 Transaction Managers with laser bar code readers and 32 Port Concentrators. Printers included 100 LaserJet 5L printers; three LaserJet 5SiMX printers; and two Type II Bar Code Printers. The relational database management system included an HP 9000 T600 Mid-Tier Server including Oracle full development software license for 250 simultaneous users.

The DCS is into its third month of operation and is undergoing refinements. It continues to be populated with data being converted from the old system, collected from bar-coded badges and work instructions, and manual input. DCS is capable of performing real time entry through its bar code data collection system. The DCS is currently in its initial phase of fielding in the Rotating Electric and Blade shops. The second phase will include one aircraft line later in 1998, and the final phase is scheduled for implementation throughout the remaining Depot operations during 1999. When completed, the DCS will provide the Depot a toolbox of information for financial and personnel applications, material applications, and maintenance applications. With a completed repository of data, it will be possible to accurately report material and labor status, list open work orders, generate work orders to include procedures and routings, and update the scheduling and statement of work application components. DCS will simplify the Work Breakdown Structure, eliminate redundant processes, and provide greater accuracy for each requirement.

The DCS is currently in its initial phase of fielding, with plans to complete its final phase toward the end of 1999. To complete this schedule, continued development and initial data loading remains to be completed. The benefits projected by full implementation of the DCS are far reaching. An illustration of this is the availability of tracking open work orders at the lowest level of detail within seconds versus what would have taken months.

The project represents four strategically significant steps within systems development for the Army Maintenance community:

- It provides a mid-tier relational database in an open architecture environment for its users.
- The database model is being developed with the standard DoD data dictionary.
- The common user interface of the HTML provides a seamless environment for the users to access information pertinent to their work instruction; it further provides management, customer, and headquarter visibility of the process that is presently unthinkable.
- The bar coding and computer infrastructure being configured for the shop floor provides a basis of data collection that is needed regardless of the application being run.

Facilities

Spill Management Team

CCAD's Spill Management Team provides expert handling of hazardous waste materials. CCAD is a Treatment, Storage, and Disposal (TSD) facility as defined by the Resource Conservation and Recovery Act (1976). The Occupational Safety and Health Administration (OSHA) regulation on Hazardous Waste Operations and Emergency Response (29 CFR Part 1910.120) requires TSD facilities to develop an emergency response plan to handle an uncontrolled release of a hazardous substance.

Prior to 1986, hazardous waste spills were handled by the Naval Air Station (NAS) environmental personnel. In 1986, CCAD established its own spill management team, which consists of personnel trained in accordance with OSHA 29 CFR 1910.120. This training included instruction on the clean up and handling of hazardous materials as well as using personal protective equipment. The CCAD spill response team is made up of eight certified hazardous material handlers. All response team personnel must meet annual training requirements as outlined in the OSHA regulation.

In 1992, the CCAD team entered into an interservice support agreement with the NAS fire department. Under this agreement, the fire department is the "First Responder" to CCAD hazardous spills, and is responsible for containment of the material and contacting the CCAD response team to perform a more aggressive clean up and removal of the waste.

The establishment of the CCAD Spill Response Team has greatly improved CCAD's effectiveness in handling hazardous waste spills. The response team has also helped to heighten employee awareness of hazardous waste handling rules and regulations, which has contributed to a decrease in the number of occurrences of hazardous waste spills.

Management

360 Degree Assessment

As part of CCAD's plan to develop into an HPO, the 360 degree assessment on individual performance is being piloted in the Corporate Performance Office (CPO). This method of feedback to an individual (by peers, customers, and supervisors) is designed to provide more accurate feedback about an individual's performance. Implementation of 360 degree assessment is intended to provide the organization with a measurement tool that identifies individual, team, and organizational strengths and weaknesses, as well as areas for development.

Prior to implementing this program in the CPO, performance feedback came from two possible sources. The first source was the traditional supervisor/subordinate performance appraisal, and the second source was a limited feedback form provided by the individual's customers. The limited feedback form involved ten questions in areas of general competencies; however, a subsequent action plan was not developed as a result of this feedback.

With the 360 degree assessment program, six people (four peers selected by the rated individual, the supervisor, and a self assessment by the individual) assess the individual in the six general areas of Mission/Vision/Value, Team Work, Managing Resources, Professional/Technical Knowledge, Business Skills, and Customer Service. There are 45 measurable elements in these six areas as well as narrative comments. Each element is measured on a scale of one to ten.

Confidential feedback is received only by the individual on which he or she can analyze strengths and weaknesses. The individual uses this feedback as the basis to develop a personal action plan. The personal action plan can be used at the individual's option as a point of discussion to develop performance factors for official evaluation.

Implementation of this pilot program in the CPO is now mid-way through the first cycle. The benefits of this feedback in pursuing an HPO are already being recognized. The CPO completed the first sur-

veys in July 1997, and scoring took place in September. Feedback reports were reviewed with the individuals involved in the pilot program during a workshop in December 1997. As a result of the first survey, the team scores identified Customer Service as a combined strength, and Managing Resources as an overall weakness. In support of becoming an HPO, CCAD is planning to implement the 360 degree assessment program throughout all areas of the Depot.

Activity Based Costing Efforts

Since 1996, CCAD has used Activity Based Costing (ABC) to support process improvements. ABC is being used to support the Depot in its efforts to become certified in the Contractor Performance Certification Program (CP^2)/ISO9002. Specifically, ABC analysis has been used to determine what percentage of total Depot costs are used to support quality. The ABC analysis quantified the costs for the CP^2 certification criteria.

Costs are collected at 374 different activities within the Depot and rolled up to the six core business processes of CCAD. The ABC support team provides software support and training to all Depot managers. This allows managers to focus on their piece of the Depot and analyze how their decisions affect overall product costs charged to the customers. Although this is not a novel application of ABC, it is a very good use of ABC which has provided the Depot with useful data.

The next step in the program is to migrate into Activity Based Management (ABM). CCAD envisions using ABM in supporting a variety of Depot initiatives such as benchmarking, performance measurement, and process analysis. The first application of ABM will be used to support business process re-engineering efforts.

Building High Performance Teams Through Experiential Education

High performance organizational training was adopted at CCAD to provide managers and employees with a methodology to diagnose the organization, determine what needs attention, and to use the appropriate levers to improve those areas requiring assistance. The methodology provides organizations transformational assistance. With the assistance of high performance training, CCAD is able to review its present method of conducting business and bridge the gaps that exist between current operations and what they ascertain is high performance.

Enhancing this high performance organizational training is a program called HEARTS. The acronym, which stands for Honesty, Ethics, Accountability, Respect, Trust and Support, denotes the program's fundamental principles. In January 1994, the decision to adopt this new approach to team enhancement was made by the commanding officer at the Depot. HEARTS is designed to lead the Depot's labor and management away from a confrontational relationship toward a cooperative arrangement.

The HEARTS system presents employees with a series of mental and physical challenges that alter the way they work together to solve problems, overcome obstacles, and reach goals (Figure 3-2). The Depot has completed the first of three phases of the program (HEARTS 1). In HEARTS 1, participants climb a 35-foot pole to stand on an 18-inch disk and traverse suspended wires to challenge their comfort zones. The experience helps strengthen the bonds between team members and relieves the friction that has existed over the years. Confidence and self-esteem are further bolstered as members

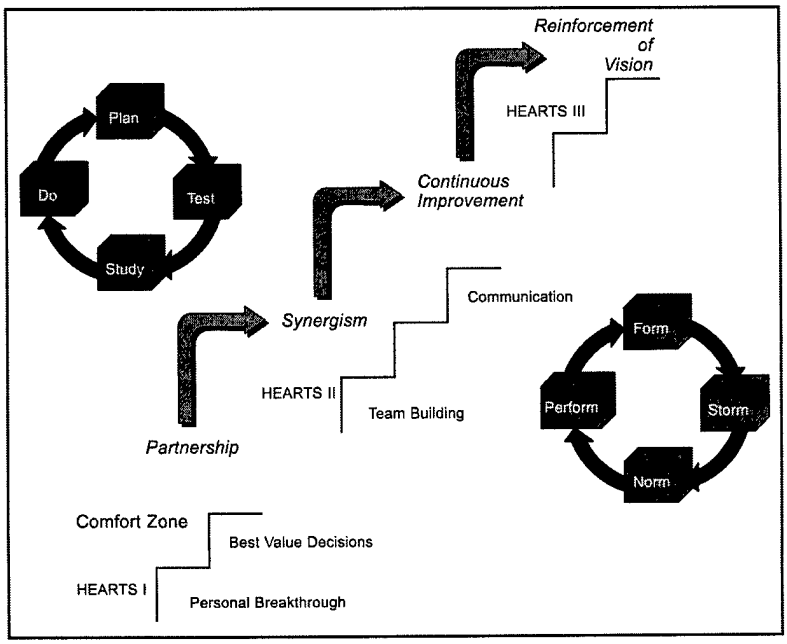

Figure 3-2. HEARTS Summary

conquer unknown fears and personal inhibitions. HEARTS 2 has been designed to aid in promoting team building, synergism, and improved communications. CCAD began this phase in January 1996. Thus far, 600 of the approximately 2,700 Depot employees have been through the training. HEARTS 3 will tie all prior learning together with the principles of continuous improvement. The Depot has deemed HEARTS a total success.

Civilian Personnel Advisory Center

The National Performance Review recommended the DoD regionalize and modernize (through automation) the civilian personnel process. In compliance with this recommendation, several regional Civilian Personnel Operations Centers (CPOCs) were established during 1997 to assume the personnel processing functions for all the individual installations within their regions. CCAD became part of the southwest regional center located at Fort Riley, Kansas. A local Civilian Personnel Advisory Center (CPAC) was retained at the Installation to serve as an intermediary between the functional managers at CCAD and the CPOC, and to provide expert advice in all personnel classification and recruitment/placement actions. The CCAD personnel process was transferred to the regional CPOC on March 1, 1997.

Prior to regionalization, CCAD personnel actions were handled by 42 people within the Directorate of Personnel. Regionalization was intended to standardize the processes through use of new automated data and processing systems applied universally throughout all regions resulting in more efficient job classification, recruitment and placement actions. As part of the regionalization, many of the actions previously processed with paperwork from functional offices to the Directorate of Personnel, now are input directly by the functional managers and processed by automated systems to the regional site. The intended result is less paper, more consistency, and reduced duplication of effort.

CCAD decided early in the program that advanced planning was key to the success of this functional change. As a result, a transition team was established a full year-and-a-half before the scheduled transfer. This team identified the following goals in making a transition as smooth and effective as possible:

- Accomplish reorganization; take care of the people
- Maintain high customer satisfaction
- Reduce reliance on paper driven operations
- Support and facilitate the southwest region CPOC/CPAC stand up

In order to provide time for the planning and transfer effort, CCAD contracted with the Office of Personnel Management for recruitment and placement services, and with a contractor for classification determinations. This reduced the daily processing workload to allow time to plan out a smooth transition; and learn the new automated systems which include COREDOC (classification activity), SWERP (recruiting), PERSACTION (personnel actions), REGIONAL (position data), and TRAIN (training requests).

The extensive pre-planning was effective in making a smooth transition to the CPOC/CPAC structure as scheduled in March 1997. The personnel resources at the local installation were reduced from 42 before regionalization to twenty. The CPOC charges the Installation for the support provided. Problems subsequent to regionalization are worked through on a cooperative basis between CCAD and the regional office as the automated applications are being matured and put on line. The ultimate benefits and cost effectiveness of the regional approach will be proven out when all installations stand up in the region, and the new processes are fully implemented.

Continuous Improvement Process Regulation

CCAD's Corporate Performance Office has documented the various planned and previously implemented continuous improvement initiatives in a single installation regulation. This document is applicable to all attached organizational elements of CCAD, and prescribes the policies, responsibilities, and procedures for developing, implementing, and managing an Installation-wide continuous improvement process.

A variety of employee involvement and quality initiatives have been implemented by CCAD organizations since 1980. These have included quality circles, quality management boards, process action teams, special task force teams, and self-managed work teams. Teams have been trained in group dynamics, problem solving techniques, leader training, researching and gathering data, cost benefit analysis, and preparing presentations for project approval. Generally these initiatives were located in pocket areas of CCAD rather than being universally

understood and implemented. Total Army Quality Specialists worked with specific directorates/divisions/branches over the years to establish plans for growth and development of teaming initiatives. These efforts resulted in many successes and excellence awards for team performance, tangible/intangible benefits, Secretary of Defense Excellence Awards, President Al Gore's Hammer Award, Association of Quality and Participation Team Excellence Awards and presentations. It was recognized that continuing efforts needed to be institutionalized to remain integral to evolving strategic planning and Executive Leadership Team directions.

As a result, in May 1997, the Corporate Performance Office facilitated formation of a Continuous Improvement Process (CIP) Documentation Team tasked with the development of a CIP regulation to define the teams, flowchart the process, and identify responsibilities in implementing continuous improvement strategies. On October 27, 1997, regulation CCADR 5-11, Continuous Improvement Process, was issued which defined executive, senior, division, and branch level Leadership teams, their relation to each other, and their role in continuous improvement for the Installation as a whole. The evolving roles of CIP teams and Self-Managing Working teams were also defined. The responsibilities of the traditional CCAD organizations relating to continuous improvement were set up in a matrix with the Executive Leadership Team given overarching oversight. A separate document of guidelines for facilitating the Continuous Improvement Process team efforts was also developed to supplement the regulation.

This effort to plan and document the CIP is essential for tying together all the related initiatives and team efforts within CCAD. The new regulation ensures that these efforts are in consonance with the direction being pursued through strategic planning. By documenting the stages and responsibilities in this process, CCAD has a step-by-step blueprint for attaining High Performance goals in cost, quality, and schedule. Follow-on steps include the Executive Leadership Team developing a CIP policy statement, reviewing source documents, selecting key performance indicators, and appointing action officers with responsibilities for reporting the indicators. The year 1998 will be a base year for metrics and performance goals to measure continuous improvement success.

Executive Leadership Team

CCAD established the Executive Leadership Team (ELT) to focus Depot resources on improving overall performance. High performance at CCAD is defined as Product and Service Quality, and Customer Value—meeting required production schedules, at or better than, the agreed upon price.

Over the last several years, CCAD has experienced several significant changes in the way it conducts business. Changes in product mix, changes in customers, and significant changes in funding have impacted the way CCAD conducts daily business. The environment in which CCAD competes is much different than it was eight to ten years ago. Because of this dynamic environment, CCAD has established the ELT to focus and channel increasingly limited Depot resources.

The ELT operates much like a corporate board, developing Depot policy and evaluating Depot performance. One of the key functions of the ELT is to shift Depot leaders from acting alone to becoming more like "stewards" of the organization. The goal of the ELT is to posture the Depot to be proactive rather than reactive — that is, focus the whole Depot on a common vision and develop comprehensive strategic goals and long range plans. The ELT works on six levers to achieve higher performance: leadership, vision, values, strategy, structure, and systems. Working each of these levers concurrently allows CCAD to focus on its goals of excellent products, customer value, and sound financial performance.

Group Award Plan

In 1994, CCAD designed a bonus plan to replace the various existing performance awards. This was called the Group Award Plan (GAP), and was intended to supplement the new teaming initiatives with Installation-wide monetary awards commensurate with Installation-wide performance.

Prior to 1994, CCAD used the traditional Government award system to recognize people who demonstrated extra effort or received outstanding performance ratings. Approximately 25% of the workforce received some type of award on a yearly basis. These included performance based monetary awards, quality step increases, special acts, and on-the-spot awards. As CCAD migrated to the team approach in all levels of management and functional perfor-

mance, there was a concern that many people were not being recognized for their efforts. It was also recognized that in a team effort, the average performer contributed a great deal to the team and Installation performance, and therefore deserved recognition as well as the outstanding performers. In support of the teaming concepts, the GAP was developed and instituted as a replacement to the traditional award system.

The first year of implementation of group awards was 1994. Both the group award concept and the pay out parameters were negotiated and agreed on by the local union. The plan itself was also concurred with by the Headquarters IOC. In the first year, the awards were based on attaining cost and revenue goals with $450 being awarded for attaining each parameter. The pay out was $900 for every employee based on the overall Installation's performance. In 1995, the same parameters were agreed to by CCAD and the union; however, the revenue goal was not met and, as a result, the total award was $450 per employee. The parameters since then have been based on CCAD installation net operating results (NOR) which took into account both cost and revenue. Meeting this goal has been a requirement for any level award. In 1997, schedule conformance was added as a goal for additional money if the NOR goal was met; and in 1998, cost, schedule, and quality were each considered for increased award amounts. This is consistent with the Executive Level Team strategic goal of making CCAD a High Performance installation.

No award money was distributed in 1996 or 1997 due to not meeting the NOR threshold, even though other goals such as schedule were met. Efforts have been underway to consider all parameters equally in getting some level of award pay out instead of having NOR as the first screen out. Success in changing this in the evolution of the GAP is considered critical to the future success of this program, since the possibility of three consecutive years without any awards would affect support for continuing the program. Results for 1998 and the treatment of NOR will be pivotal for the future effectiveness of GAP as an alternative to traditional award systems.

Marketing Program

During the prosperous years of the 1970s and 1980s, money was readily available to support CCAD's aircraft overhaul programs. A customer would send an aircraft to the Depot for either repair or overhaul and expect a brand new product to be returned to them. The feedback system for customer complaints was usually the telephone.

With the 1990s, money became tighter. The customer was no longer getting the complete service, but was still expecting it. The Depot was only doing the specific maintenance required, and communication was not in sync with the change so the customer became confused. Realizing a need to improve customer relations, CCAD formed a Business Development and Marketing Office in 1994. One of the tasks performed by this office has been the development of informational products which are geared toward providing information about specific processes, capabilities, and services. CCAD's objective has been to improve its image by increasing customer awareness and, at the same time, improve the communication process. The end results—a creation of exchanges between CCAD and customers, objectives were met, and customers were satisfied.

One of the strategies developed by the marketing group at CCAD was to create videos which tell the customer exactly what service can be expected from the Depot, and to ensure full understanding of the specific program's scope of work. This product's development process includes the research on the scope of work requirement and determination of important features that the customer needs to understand. A script is then developed, and a team of functional experts review and edit the script before it is sent to CCAD's video production office. Once the video is produced, reviewed, and edited by the Marketing Office, the final production takes place. The video is then reproduced and is ready for final distribution to the customer.

Products developed thus far by the Depot include a Manufacturing Capabilities video; the UH-60 Refurbishment Program video; Navy/Marine Corps Standard Depot Level Maintenance Program video and pamphlet; and, presently in draft form, the CH-47D Refurbishment Program video and tri-fold brochure. Future considerations include Apache Longbow Pre-Mod Program and an updated Manufacturing New Capabilities video.

Myers-Briggs Type Indicator

CCAD has implemented the use of Myers-Briggs Type Indicator (MBTI) analysis to help strengthen inter-depot communications and improve and foster teamwork. Briefly, MBTI classifies individuals into 16 different personality types and profiles the

characteristics associated with each type of personality. The ultimate goal is to help Depot employees increase their self-development in skills that can be used both at work and other settings. MBTI is the first in a series of four courses that CCAD is using in training Depot personnel for new work environments and new ways of conducting business.

The Depot offers a two-day initial workshop to profile employees and explain the differences in personality types of normal, healthy people. Follow-on MBTI courses are offered to employees to strengthen the application of MBTI analysis. The ultimate objective is to train a more flexible and effective workforce. The MBTI is not a panacea. For example, it will not solve severe personality quirks. It is a powerful tool in fostering a better understanding of people's traits and how this understanding can help create a more effective workplace. MBTI, created by Katherine Briggs and Isabel Briggs Myers, has been available to the public since 1975. CCAD has been using MBTI effectively for the past two years. It is part of an overall CCAD commitment to improve interpersonal relationships and effective teamwork.

Seven Habits of Highly Effective People

CCAD has implemented the training of Stephen R. Covey's "Seven Habits of Highly Effective People" for all Depot personnel. This training is being conducted to help foster and strengthen teamwork. Briefly, Covey's analysis reviewed people in leadership positions throughout history and determined that effective leaders possess the same identifiable traits—traits that allow these people to be successful in a variety of occupations. Covey found that the seven character traits foster inter-dependence among people, thereby attaining a state of continuous improvement. This is a training goal at CCAD.

The Covey training is part of four very effective training programs at CCAD. These programs are the vehicles that CCAD is using to develop the workforce and increase the people skills of all employees. The ultimate goal of this and other programs (e.g., MBTI, HPO, HEARTS) is to create a workforce that will be productive and flexible enough to achieve a 30% reduction of costs at the Depot over the next few years. CCAD is investing up-front in employees to achieve success in the future.

Appendix A

Table of Acronyms

Acronym	Definition
ABC	Activity Based Costing
ABM	Activity Based Management
AIB	Analytical Investigation Branch
CCAD	Corpus Christi Army Depot
CIP	Continuous Improvement Process
CPAC	Civilian Personnel Advisory Center
CPO	Corporate Performance Office
CPOC	Civilian Personnel Operations Center
CP^2	Contractor Performance Certification Program
CTX	Centers of Technical Exchange
DCS	Data Collection System
DM-HMMS	Depot Maintenance Hazardous Materials Management System
DoD	Department of Defense
EI	Engineering Investigation
EIR	Equipment Inspection Report
ELT	Executive Leadership Team
GAP	Group Award Plan
HEARTS	Honesty, Ethics, Accountability, Respect, Trust, and Support
HPO	High Performing Organization
HTML	Hyper Text Markup Language
IOC	Industrial Operations Command
MBTI	Myers-Briggs Type Indicator
MIS	Management Information System
NAS	Naval Air Station
NOR	Net Operating Results
OSHA	Occupational Safety and Health Administration
PDMSS	Programmed Depot Maintenance Scheduling System
PMB	Plastic Media Blasting
PP	Pollution Prevention

Acronym	Definition
RBWA	Route By Walking About
SAFR	Storage, Analysis, Failure Evaluation, and Reclamation
SWOT	Strengths, Weaknesses, Opportunities, and Threats
TSD	Treatment, Storage, and Disposal
VOC	Volatile Organic Compound
WJNCMC	Waterjet Numerically Controlled Machining Center

Appendix B

BMP Survey Team

Team Member	Activity	Function
Larry Robertson (812) 854-5336	**Crane Division** **Naval Surface Warfare Center** Crane, IN	**Team Chairman**
Dan Carlson (309) 782-6475	**U.S. Army** **Industrial Operations Command** Rock Island, IL	**Technical Writer**
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Rick Purcell (301) 403-8100	**BMP Center of Excellence** College Park, MD	**Team Leader**
Robert Cale (518) 266-5300	**Watervliet Arsenal** Watervliet, NY	
Tim Donnelly (309) 782-3655	**U.S. Army** **Industrial Operations Command** Rock Island, IL	
John Moore* (309) 782-1971	**U.S. Army** **Industrial Operations Command** Rock Island, IL	
	Team 2	
Larry Halbig (317) 306-3838	**Hughes Aircraft Division** Indianapolis, IN	**Team Leader**
Greta Gadson (703) 271-9055	**Production Technology, Incorporated** Arlington, VA	
Byung Kim (217) 373-3481	**U.S. Army Corps Of Engineers** Champaign, IL	
John Moore* (309) 782-1971	**U.S. Army** **Industrial Operations Command** Rock Island, IL	

*John Moore participated as a team member on Team 1 and Team 2.

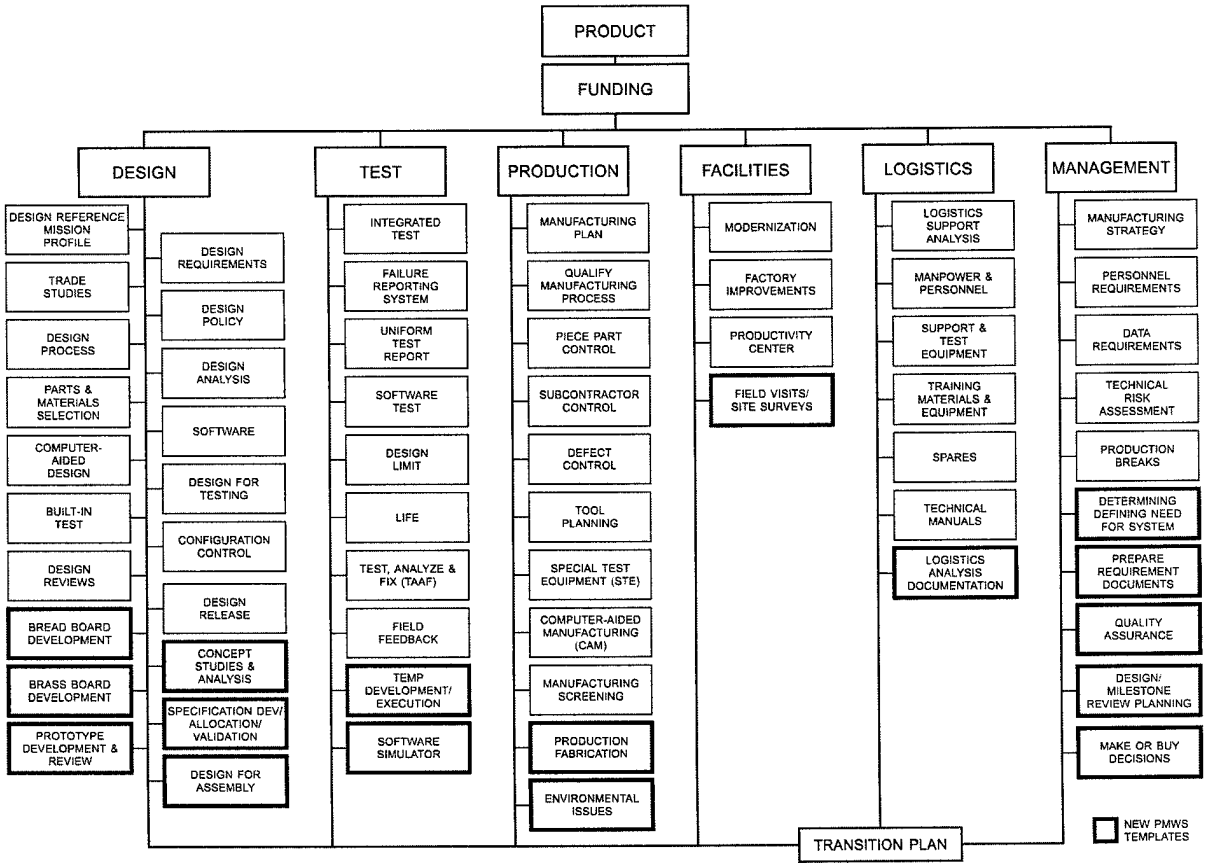
Appendix C

Critical Path Templates and BMP Templates

This survey was structured around and concentrated on the functional areas of design, test, production, facilities, logistics, and management as presented in the Department of Defense 4245.7-M, *Transition from Development to Production* document. This publication defines the proper tools—or templates—that constitute the critical path for a successful material acquisition program. It describes techniques for improving the acquisition process by addressing it as an *industrial* process that focuses on the product's design, test, and production phases which are interrelated and interdependent disciplines.

The BMP program has continued to build on this knowledge base by developing 17 new templates that complement the existing DOD 4245.7-M templates. These BMP templates address new or emerging technologies and processes.

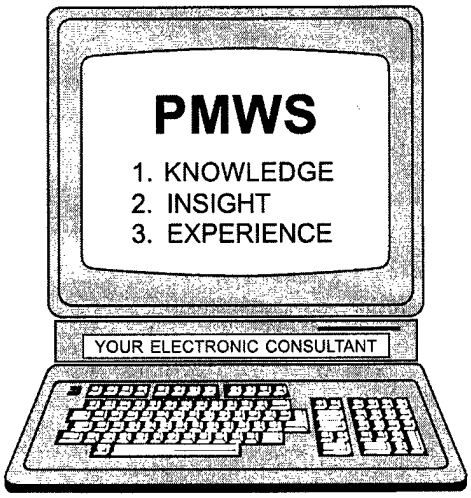
"CRITICAL PATH TEMPLATES FOR TRANSITION FROM DEVELOPMENT TO PRODUCTION"



Appendix D

BMPnet and the Program Manager's WorkStation

The BMPnet, located at the Best Manufacturing Practices Center of Excellence (BMPCOE) in College Park, Maryland, supports several communication features. These features include the Program Manager's WorkStation (**PMWS**), electronic mail and file transfer capabilities, as well as access to Special Interest Groups (SIGs) for specific topic information and communication. The BMPnet can be accessed through the World Wide Web (at http://www.bmpcoe.org), through free software that connects directly over the Internet or through a modem. The PMWS software is also available on CD-ROM.



PMWS provides users with timely acquisition and engineering information through a series of interrelated software environments and knowledge-based packages. The main components of PMWS are KnowHow, SpecRite, the Technical Risk Identification and Mitigation System (TRIMS), and the BMP Database.

KnowHow is an intelligent, automated program that provides rapid access to information through an intelligent search capability. Information currently available in KnowHow handbooks includes Acquisition Streamlining, Non-Development Items, Value Engineering, NAVSO P-6071 (Best Practices Manual), MIL-STD-2167/2168 and the DoD 5000 series documents. KnowHow cuts document search time by 95%, providing critical, user-specific information in under three minutes.

SpecRite is a performance specification generator based on expert knowledge from all uniformed services. This program guides acquisition personnel in creating specifications for their requirements, and is structured for the build/approval process. SpecRite's knowledge-based guidance and assistance structure is modular, flexible, and provides output in MIL-STD 961D format in the form of editable WordPerfect® files.

TRIMS, based on DoD 4245.7-M (the transition templates), NAVSO P-6071, and DoD 5000 event-oriented acquisition, helps the user identify and rank a program's high-risk areas. By helping the user conduct a full range of risk assessments throughout the acquisition process, TRIMS highlights areas where corrective action can be initiated before risks develop into problems. It also helps users track key project documentation from concept through production including goals, responsible personnel, and next action dates for future activities.

The **BMP Database** contains proven best practices from industry, government, and the academic communities. These best practices are in the areas of design, test, production, facilities, management, and logistics. Each practice has been observed, verified, and documented by a team of government experts during BMP surveys.

Access to the BMPnet through dial-in or on Internet requires a special modem program. This program can be obtained by calling the BMPnet Help Desk at (301) 403-8179 or it can be downloaded from the World Wide Web at http://www.bmpcoe.org. To receive a user/e-mail account on the BMPnet, send a request to helpdesk@bmpcoe.org.

Appendix E

Best Manufacturing Practices Satellite Centers

There are currently nine Best Manufacturing Practices (BMP) satellite centers that provide representation for and awareness of the BMP program to regional industry, government and academic institutions. The centers also promote the use of BMP with regional Manufacturing Technology Centers. Regional manufacturers can take advantage of the BMP satellite centers to help resolve problems, as the centers host informative, one-day regional workshops that focus on specific technical issues.

Center representatives also conduct BMP lectures at regional colleges and universities; maintain lists of experts who are potential survey team members; provide team member training; identify regional experts for inclusion in the BMPnet SIG e-mail; and train regional personnel in the use of BMP resources such as the BMPnet.

The nine BMP satellite centers include:

California

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Appendix F

Navy Manufacturing Technology Centers of Excellence

The Navy Manufacturing Sciences and Technology Program established the following Centers of Excellence (COEs) to provide focal points for the development and technology transfer of new manufacturing processes and equipment in a cooperative environment with industry, academia, and Navy centers and laboratories. These COEs are consortium-structured for industry, academia, and government involvement in developing and implementing technologies. Each COE has a designated point of contact listed below with the individual COE information.

Best Manufacturing Practices Center of Excellence

The Best Manufacturing Practices Center of Excellence (BMPCOE) provides a national resource to identify and promote exemplary manufacturing and business practices and to disseminate this information to the U.S. Industrial Base. The BMPCOE was established by the Navy's BMP program, Department of Commerce's National Institute of Standards and Technology, and the University of Maryland at College Park, Maryland. The BMPCOE improves the use of existing technology, promotes the introduction of improved technologies, and provides non-competitive means to address common problems, and has become a significant factor in countering foreign competition.

Point of Contact:
Mr. Ernie Renner
Best Manufacturing Practices Center of Excellence
4321 Hartwick Road
Suite 400
College Park, MD 20740
(301) 403-8100
FAX: (301) 403-8180
ernie@bmpcoe.org

Center of Excellence for Composites Manufacturing Technology

The Center of Excellence for Composites Manufacturing Technology (CECMT) provides a national resource for the development and dissemination of composites manufacturing technology to defense contractors and subcontractors. The CECMT is managed by the GreatLakes Composites Consortium and represents a collaborative effort among industry, academia, and government to develop, evaluate, demonstrate, and test composites manufacturing technologies. The technical work is problem-driven to reflect current and future Navy needs in the composites industrial community.

Point of Contact:
Dr. Roger Fountain
Center of Excellence for Composites Manufacturing Technology
103 Trade Zone Drive
Suite 26C
West Columbia, SC 29170
(803) 822-3705
FAX: (803) 822-3730
rfglcc@glcc.org

Electronics Manufacturing Productivity Facility

The Electronics Manufacturing Productivity Facility (EMPF) identifies, develops, and transfers innovative electronics manufacturing processes to domestic firms in support of the manufacture of affordable military systems. The EMPF operates as a consortium comprised of industry, university, and government participants, led by the American Competitiveness Institute under a CRADA with the Navy.

Point of Contact:
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Electronics Manufacturing Productivity Facility
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(610) 832-8800
FAX: (610) 832-8810
http://www.engriupui.edu/empf/

National Center for Excellence in Metalworking Technology

The National Center for Excellence in Metalworking Technology (NCEMT) provides a national center for the development, dissemination, and implementation of advanced technologies for metalworking products and processes. The NCEMT, operated by Concurrent Technologies Corporation, helps the Navy and defense contractors improve manufacturing

productivity and part reliability through development, deployment, training, and education for advanced metalworking technologies.

Point of Contact:
Mr. Richard Henry
National Center for Excellence in Metalworking Technology
1450 Scalp Avenue
Johnstown, PA 15904-3374
(814) 269-2532
FAX: (814) 269-2799
henry@ctc.com

Navy Joining Center

The Navy Joining Center (NJC) is operated by the Edison Welding Institute and provides a national resource for the development of materials joining expertise and the deployment of emerging manufacturing technologies to Navy contractors, subcontractors, and other activities. The NJC works with the Navy to determine and evaluate joining technology requirements and conduct technology development and deployment projects to address these issues.

Point of Contact:
Mr. David P. Edmonds
Navy Joining Center
1100 Kinnear Road
Columbus, OH 43212-1161
(614) 487-5825
FAX: (614) 486-9528
dave_edmonds@ewi.org

Energetics Manufacturing Technology Center

The Energetics Manufacturing Technology Center (EMTC) addresses unique manufacturing processes and problems of the energetics industrial base to ensure the availability of affordable, quality energetics. The focus of the EMTC is on process technology with a goal of reducing manufacturing costs while improving product quality and reliability. The COE also maintains a goal of development and implementation of environmentally benign energetics manufacturing processes.

Point of Contact:
Mr. John Brough
Energetics Manufacturing Technology Center
Indian Head Division
Naval Surface Warfare Center
Indian Head, MD 20640-5035
(301) 743-4417
DSN: 354-4417
FAX: (301) 743-4187
mt@command.nosih.sea06.navy.mil

Manufacturing Science and Advanced Materials Processing Institute

The Manufacturing Science and Advanced Materials Processing Institute (MS&AMPI) is comprised of three centers including the National Center for Advanced Drivetrain Technologies (NCADT), The Surface Engineering Manufacturing Technology Center (SEMTC), and the Laser Applications Research Center (LaserARC). These centers are located at The Pennsylvania State University's Applied Research Laboratory. Each center is highlighted below.

Point of Contact for MS&AMPI:
Mr. Henry Watson
Manufacturing Science and Advanced Materials Processing Institute
ARL Penn State
P.O. Box 30
State College, PA 16804-0030
(814) 865-6345
FAX: (814) 863-1183
hew2@psu.edu

- **National Center for Advanced Drivetrain Technologies**
  The NCADT supports DoD by strengthening, revitalizing, and enhancing the technological capabilities of the U.S. gear and transmission industry. It provides a site for neutral testing to verify accuracy and performance of gear and transmission components.

  Point of Contact for NCADT:
  Dr. Suren Rao
  NCADT/Drivetrain Center
  ARL Penn State
  P.O. Box 30
  State College, PA 16804-0030
  (814) 865-3537
  FAX: (814) 863-6185
  http://www.arl.psu.edu/drivetrain_center.html/

- **Surface Engineering Manufacturing Technology Center**

  The SEMTC enables technology development in surface engineering—the systematic and rational modification of material surfaces to provide desirable material characteristics and performance. This can be implemented for complex optical, electrical, chemical, and mechanical functions or products that affect the cost, operation, maintainability, and reliability of weapon systems.

  Point of Contact for SEMTC:
  Dr. Maurice F. Amateau
  SEMTC/Surface Engineering Center
  P.O. Box 30
  State College, PA 16804-0030
  (814) 863-4214
  FAX: (814) 863-0006
  http://www/arl.psu.edu/divisions/arl_org.html

- **Laser Applications Research Center**

  The LaserARC is established to expand the technical capabilities of DOD by providing access to high-power industrial lasers for advanced material processing applications. LaserARC offers basic and applied research in laser-material interaction, process development, sensor technologies, and corresponding demonstrations of developed applications.

  Point of Contact for LaserARC:
  Mr. Paul Denney
  Laser Center
  ARL Penn State
  P.O. Box 30
  State College, PA 16804-0030
  (814) 865-2934
  FAX: (814) 863-1183
  http://www/arl.psu.edu/divisions/arl_org.html

Gulf Coast Region Maritime Technology Center

The Gulf Coast Region Maritime Technology Center (GCRMTC) is located at the University of New Orleans and will focus primarily on product developments in support of the U.S. shipbuilding industry. A sister site at Lamar University in Orange, Texas will focus on process improvements.

Point of Contact:
Dr. John Crisp
Gulf Coast Region Maritime Technology Center
University of New Orleans
Room N-212
New Orleans, LA 70148
(504) 286-3871
FAX: (504) 286-3898

Appendix G

Completed Surveys

As of this publication, 104 surveys have been conducted and published by BMP at the companies listed below. Copies of older survey reports may be obtained through DTIC or by accessing the BMPnet. Requests for copies of recent survey reports or inquiries regarding the BMPnet may be directed to:

Best Manufacturing Practices Program
4321 Hartwick Rd., Suite 400
College Park, MD 20740
Attn: Mr. Ernie Renner, Director
Telephone: 1-800-789-4267
FAX: (301) 403-8180
ernie@bmpcoe.org

1985	Litton Guidance & Control Systems Division - Woodland Hills, CA
1986	Honeywell, Incorporated Undersea Systems Division - Hopkins, MN (Alliant TechSystems, Inc.) Texas Instruments Defense Systems & Electronics Group - Lewisville, TX General Dynamics Pomona Division - Pomona, CA Harris Corporation Government Support Systems Division - Syosset, NY IBM Corporation Federal Systems Division - Owego, NY Control Data Corporation Government Systems Division - Minneapolis, MN
1987	Hughes Aircraft Company Radar Systems Group - Los Angeles, CA ITT Avionics Division - Clifton, NJ Rockwell International Corporation Collins Defense Communications - Cedar Rapids, IA UNISYS Computer Systems Division - St. Paul, MN (Paramax)
1988	Motorola Government Electronics Group - Scottsdale, AZ General Dynamics Fort Worth Division - Fort Worth, TX Texas Instruments Defense Systems & Electronics Group - Dallas, TX Hughes Aircraft Company Missile Systems Group - Tucson, AZ Bell Helicopter Textron, Inc. - Fort Worth, TX Litton Data Systems Division - Van Nuys, CA GTE C^3 Systems Sector - Needham Heights, MA
1989	McDonnell-Douglas Corporation McDonnell Aircraft Company - St. Louis, MO Northrop Corporation Aircraft Division - Hawthorne, CA Litton Applied Technology Division - San Jose, CA Litton Amecom Division - College Park, MD Standard Industries - LaMirada, CA Engineered Circuit Research, Incorporated - Milpitas, CA Teledyne Industries Incorporated Electronics Division - Newbury Park, CA Lockheed Aeronautical Systems Company - Marietta, GA Lockheed Corporation Missile Systems Division - Sunnyvale, CA Westinghouse Electronic Systems Group - Baltimore, MD General Electric Naval & Drive Turbine Systems - Fitchburg, MA Rockwell International Corporation Autonetics Electronics Systems - Anaheim, CA TRICOR Systems, Incorporated - Elgin, IL
1990	Hughes Aircraft Company Ground Systems Group - Fullerton, CA TRW Military Electronics and Avionics Division - San Diego, CA MechTronics of Arizona, Inc. - Phoenix, AZ Boeing Aerospace & Electronics - Corinth, TX Technology Matrix Consortium - Traverse City, MI Textron Lycoming - Stratford, CT

1991	*Resurvey of Litton Guidance & Control Systems Division* - Woodland Hills, CA Norden Systems, Inc. - Norwalk, CT Naval Avionics Center - Indianapolis, IN United Electric Controls - Watertown, MA Kurt Manufacturing Co. - Minneapolis, MN MagneTek Defense Systems - Anaheim, CA Raytheon Missile Systems Division - Andover, MA AT&T Federal Systems Advanced Technologies and AT&T Bell Laboratories - Greensboro, NC and Whippany, NJ *Resurvey of Texas Instruments Defense Systems & Electronics Group* - Lewisville, TX
1992	Tandem Computers - Cupertino, CA Charleston Naval Shipyard - Charleston, SC Conax Florida Corporation - St. Petersburg, FL Texas Instruments Semiconductor Group Military Products - Midland, TX Hewlett-Packard Palo Alto Fabrication Center - Palo Alto, CA Watervliet U.S. Army Arsenal - Watervliet, NY Digital Equipment Company Enclosures Business - Westfield, MA and Maynard, MA Computing Devices International - Minneapolis, MN *(Resurvey of Control Data Corporation Government Systems Division)* Naval Aviation Depot Naval Air Station - Pensacola, FL
1993	NASA Marshall Space Flight Center - Huntsville, AL Naval Aviation Depot Naval Air Station - Jacksonville, FL Department of Energy Oak Ridge Facilities (Operated by Martin Marietta Energy Systems, Inc.) - Oak Ridge, TN McDonnell Douglas Aerospace - Huntington Beach, CA Crane Division Naval Surface Warfare Center - Crane, IN and Louisville, KY Philadelphia Naval Shipyard - Philadelphia, PA R. J. Reynolds Tobacco Company - Winston-Salem, NC Crystal Gateway Marriott Hotel - Arlington, VA Hamilton Standard Electronic Manufacturing Facility - Farmington, CT Alpha Industries, Inc. - Methuen, MA
1994	Harris Semiconductor - Melbourne, FL United Defense, L.P. Ground Systems Division - San Jose, CA Naval Undersea Warfare Center Division Keyport - Keyport, WA Mason & Hanger - Silas Mason Co., Inc. - Middletown, IA Kaiser Electronics - San Jose, CA U.S. Army Combat Systems Test Activity - Aberdeen, MD Stafford County Public Schools - Stafford County, VA
1995	Sandia National Laboratories - Albuquerque, NM Rockwell Defense Electronics Collins Avionics & Communications Division - Cedar Rapids, IA *(Resurvey of Rockwell International Corporation Collins Defense Communications)* Lockheed Martin Electronics & Missiles - Orlando, FL McDonnell Douglas Aerospace (St. Louis) - St. Louis, MO *(Resurvey of McDonnell-Douglas Corporation McDonnell Aircraft Company)* Dayton Parts, Inc. - Harrisburg, PA Wainwright Industries - St. Peters, MO Lockheed Martin Tactical Aircraft Systems - Fort Worth, TX *(Resurvey of General Dynamics Fort Worth Division)* Lockheed Martin Government Electronic Systems - Moorestown, NJ Sacramento Manufacturing and Services Division - Sacramento, CA JLG Industries, Inc. - McConnellsburg, PA
1996	City of Chattanooga - Chattanooga, TN Mason & Hanger Corporation - Pantex Plant - Amarillo, TX Nascote Industries, Inc. - Nashville, IL Weirton Steel Corporation - Weirton, WV NASA Kennedy Space Center - Cape Canaveral, FL Department of Energy, Oak Ridge Operations - Oak Ridge, TN

1997	Headquarters, U.S. Army Industrial Operations Command - Rock Island, IL
	SAE International and Performance Review Institute - Warrendale, PA
	Polaroid Corporation - Waltham, MA
	Cincinnati Milacron, Inc. - Cincinnati, OH
	Lawrence Livermore National Laboratory - Livermore, CA
	Sharretts Plating Company, Inc. - Emigsville, PA
	Thermacore, Inc. - Lancaster, PA
	Rock Island Arsenal - Rock Island, IL
	Northrop Grumman Corporation - El Segundo, CA
	(Resurvey of Northrop Corporation Aircraft Division)
	Letterkenny Army Depot - Chambersburg, PA
	Elizabethtown College - Elizabethtown, PA
	Tooele Army Depot - Tooele, UT
1998	United Electric Controls - Watertown, MA
	Strite Industries Limited - Cambridge, Ontario, Canada
	Northrop Grumman Corporation - El Segundo, CA
	Corpus Christi Army Depot - Corpus Christi, TX

INTERNET DOCUMENT INFORMATION FORM

A . Report Title: Best Manufacturing Practices: Report of Survey Conducted at Corpus Christi Army Depot, Corpus Christi, TX

B. DATE Report Downloaded From the Internet: 12/11/01

C. Report's Point of Contact: (Name, Organization, Address, Office Symbol, & Ph #): **Best Manufacturing Practices**
Center of Excellence
College Park, MD

D. Currently Applicable Classification Level: Unclassified

E. Distribution Statement A: Approved for Public Release

F. The foregoing information was compiled and provided by:
DTIC-OCA, Initials: __VM__ **Preparation Date 12/11/01**

The foregoing information should exactly correspond to the Title, Report Number, and the Date on the accompanying report document. If there are mismatches, or other questions, contact the above OCA Representative for resolution.